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ATIKOKAN TGS AQUATIC STUDIES AUGUST AND OCTOBER 1985

Report No. 87-233-K

G.T. Haymes and J.K. Kwik
Biological Research Section
Chemical Research Department

ABSTRACT

Physical, chemical and biological parameters were monitored in the Atikokan GS cooling circuit. With the exception of temperature and oxygen profiles in Moose Lake, physical and chemical parameters measured in 1985 were similar to those of previous years. In Moose Lake, the thermocline was drawn below the level of the station's intake and a lens of oxygen depletion was apparent at the depth of the thermocline. The abundance and distribution of macrophytes in the areas selected for intensive study had increased since 1983. The abundance of Elodea canadensis in Snow Lake and the East Bay of Icy Lake had increased since 1983. The catches of fish in larval tows, beach seines and gill nets were similar to previous years, except that the relative abundance of blacknose shiner in beach seine hauls continued a decline initiated in 1984.

job	file	date	report no.
34-116-492	837.321 ATI	October 19, 1987	87-233-K

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EXECUTIVE SUMMARY

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G.T. Haymes and J.K. Kwik
Biological Research Section
Chemical Research Department

Aquatic studies were conducted at Atikokan TGS during 1985 during the commissioning of the station. The objectives of the studies at Atikokan (1981-1987) are to identify changes in components of the aquatic environment as a result of station construction and operation. The studies were requested by Environmental Studies and Assessments Department.

Temperature profiles in the basins of the cooling water circuit were similar to those observed earlier with the exception of those from Moose Lake. The thermocline in Moose Lake was drawn down to approximately 13 m due to the influence of the station's submerged intake. As was reported in previous years, hypolimnetic oxygen depletion was apparent in all of the basins. A lens of oxygen depletion was observed in Moose Lake in the area of the thermocline.

Concentrations of most nutrients were similar to those observed during the preoperation phase, although nitrate levels were lower than previously recorded means.

The abundance and distribution of macrophytes in selected areas had increased since 1983. Elodea canadensis, a potentially problematic species, had increased in abundance in Snow Lake and the east bay of Icy Lake.

Yellow perch and lake whitefish were the most commonly collected fish larvae in tow nets. Yellow perch were collected in all study basins while whitefish were collected in all basins except Slush Lake.

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Yellow perch and mimic shiners were the most commonly collected fish in beach seine hauls, although Iowa darter, white sucker and blacknose shiner were relatively abundant in some basins. The relative abundance of blacknose shiner in the catch continued a decline initiated in 1984.

Although the contribution of walleye in gill net catches was relatively low in 1985, this reduction was not statistically significant.

The age distributions of walleye, northern pike, cisco and lake whitefish during the commissioning phase (1984-1985) were similar to those observed in the 1981 - 1983 period. Size at age data indicated that growth rates of northern pike, cisco and whitefish were similar in the commissioning and preoperational phases. Walleye, however, were generally smaller during the commissioning phase. This apparent difference was attributed to differences in sampling effort among years.

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To Dr. W.R. Effer
Manager
Environmental Studies and
Assessments Department
Design and Development - Generation

ATIKOKAN TGS AQUATIC STUDIES
AUGUST AND OCTOBER, 1985

1.0 INTRODUCTION

Atikokan TGS consists of one 200 MW, lignite-fired unit. Water for the condenser cooling system of the station is drawn at a maximum rate of 6.6 m^3/s from the 10 to 15 m depth of Moose Lake and discharged on the surface of Snow Lake. The discharged water circulates through Snow, Icy, Abie and Marmion Lakes before returning to Moose Lake (Figure 1).

The objectives of the environmental studies at Atikokan TGS, as requested by Environmental Studies and Assessments Department, are to document the effects of station construction and operation of Atikokan TGS on the aquatic environment. The specific objectives of commissioning and post-operational studies are to identify potential changes in components of the aquatic environment relative to the results of similar studies conducted prior to station operation (1981-1983) and to assess the validity of hypothesized effects developed during a workshop involving representatives from Ontario Hydro and the Government (Greig et al 1984).

Although originally scheduled for July 1985, the official in-service date for the unit was delayed until November 14, 1985. The results presented in this report of sampling conducted in August and October 1985 should be considered as commissioning phase; some pump operation and heat production occurred during the period.

In addition to the results of August and October sampling, results from sampling conducted April through June, which were not included in the interim study report (Ontario Hydro Research Division Report No. 85-333-K), are included here.

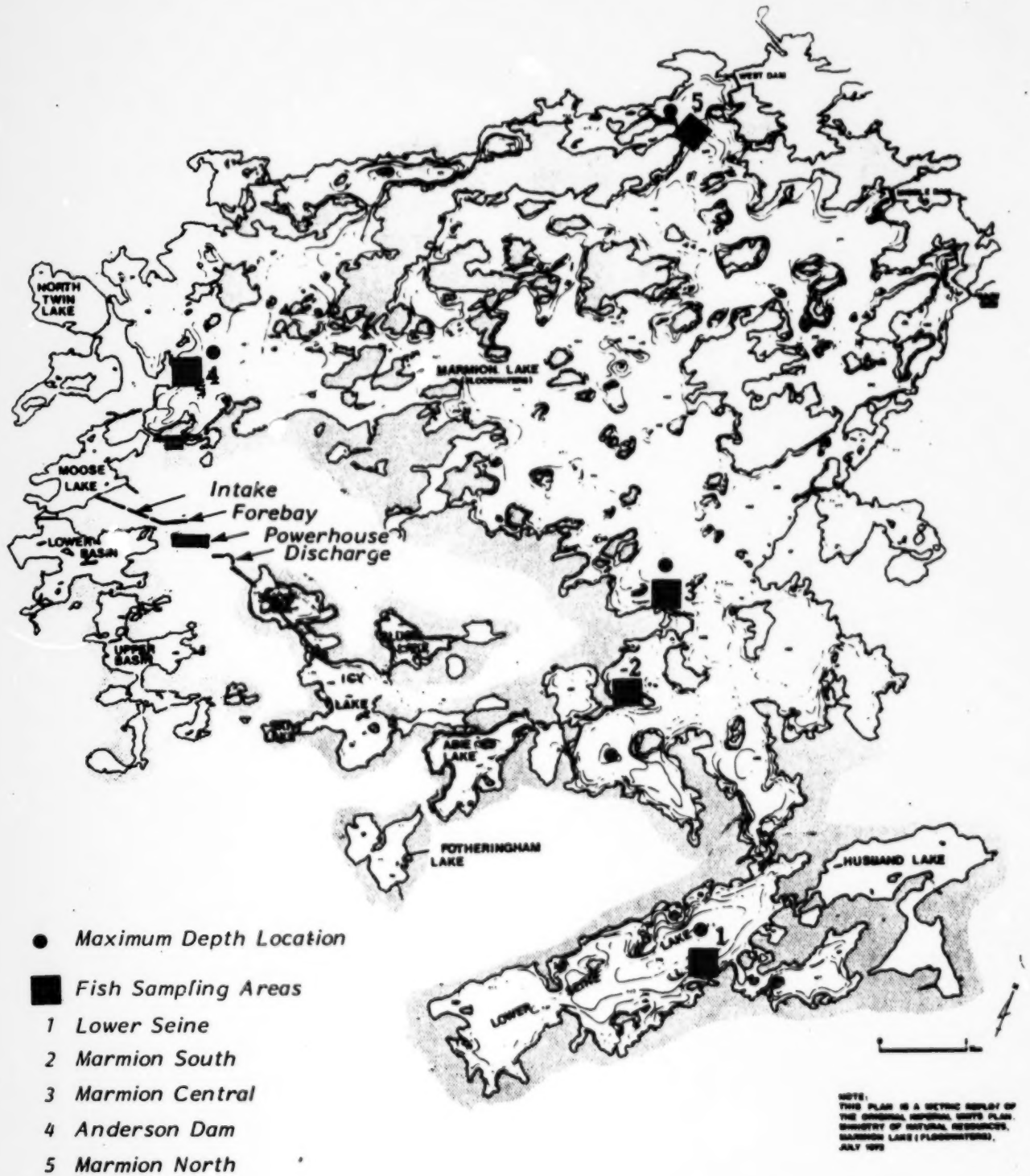

FIGURE 1
ATIKOKAN SAMPLING LOCATIONS

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2.0 STUDY AREA

The study area consists of the five lakes of the cooling circuit and Slush Lake (Figure 1). Ten locations were selected for study: one each in Snow, Icy, Abie, Slush and Moose Lakes and five locations in Marmion Lake (Marmion South, Central and North, Anderson Dam and Lower Siene). A more complete description of the study area is given in Ontario Hydro Research Division Report No. 86-38-K.

3.0 METHODS

3.1 Temperature and Dissolved Oxygen Profiles

Temperature and dissolved oxygen profiles were determined at each study location using a Hydrolab 4000 meter in August and October 1985. Readings were taken at 1 m intervals from surface to bottom.

3.2 Water Chemistry

Samples for analysis of nutrients (total and soluble phosphorus, total Kjeldahl nitrogen and nitrates) were collected from the surface and bottom of Snow, Icy, Abie and Slush Lakes and at Marmion South, North and Anderson Dam in August and October. Water samples from three locations in the Lower Basin of Moose Lake were collected in August and October for analysis of pH, total dissolved solids, suspended and dissolved iron, copper and nickel. Improper preservation techniques of the samples collected in August did not allow analysis of pH, dissolved solids and iron.

3.3 Macrophytes

The purpose of the 1985 study was to resurvey the macrophyte vegetation in the seven bays examined in 1982 and 1983. Six of the bays are on the cooling circuit and the seventh, a control, is on Slush Lake (Figure 2). The resurvey was conducted during the second week of August and was expected to provide information on any changes in species composition, depth distribution or percent bottom cover that had occurred as a result of natural causes or construction activity.

The sampling methods were the same as those used in 1982 and 1983. Within each bay, the transects established in 1982 were cruised by observers in a boat or by a snorkeller who identified the species present and described the vegetational patterns. Voucher specimens of species which were difficult to identify in

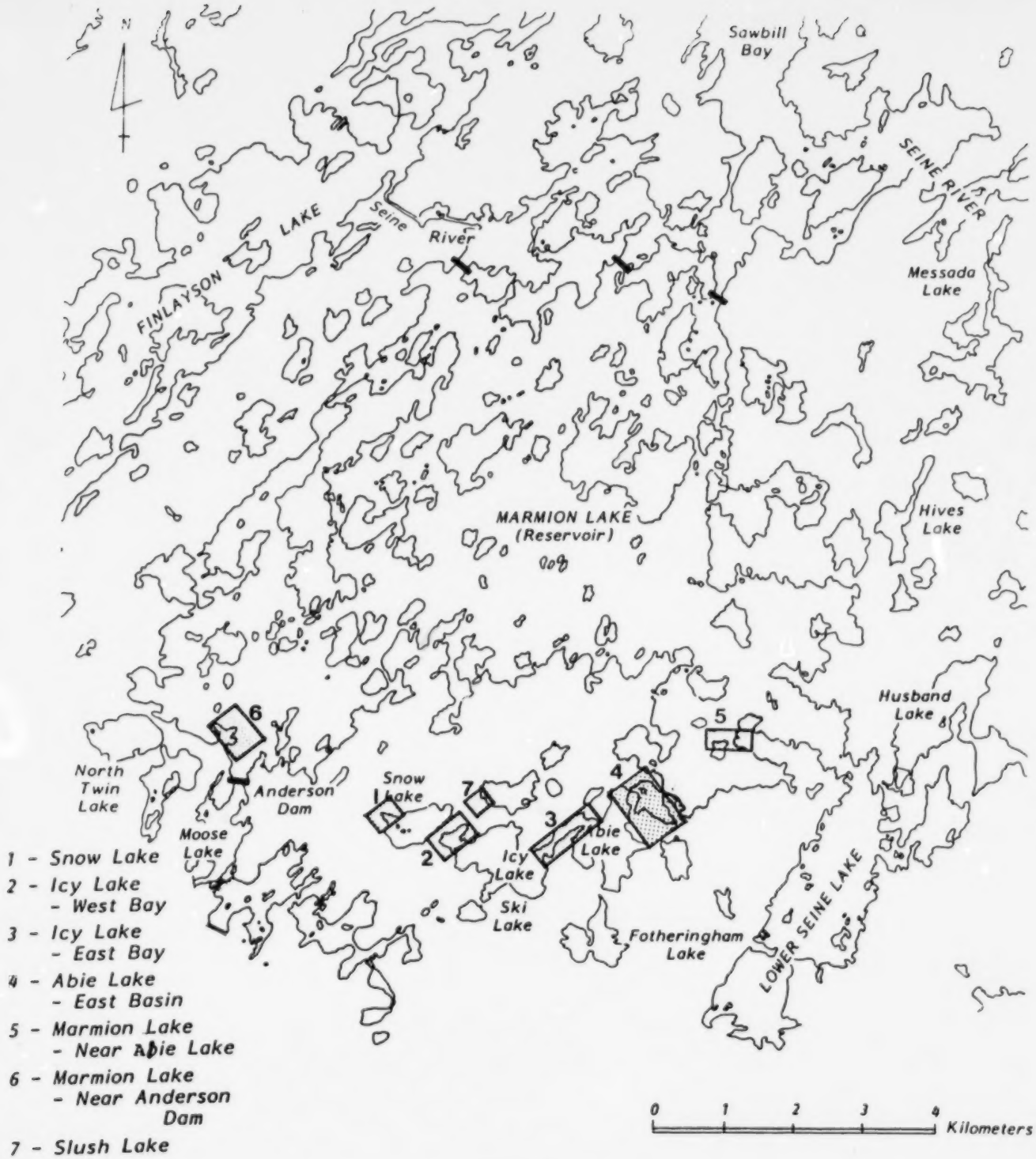

FIGURE 2

MACROPHYTE SAMPLING LOCATIONS

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the field were collected and later identified using the keys in Fassett (1975), Gleason (1968), Voss (1972), Riley (1979), Hellquist and Crow (1980) and Crow and Hellquist (1981). Maps were prepared to show the distribution of emergent, floating leafed and submergent vegetation.

3.4 Fish

Larval fish were collected in duplicate 5-minute larval tows during May at several locations throughout the cooling water circuit. Approximately 120 m^3 of water are filtered in each duplicate tow. The locations included areas near the inlets and outlets of Snow (inlet-station discharge), Icy and Abie Lakes, in Marmion Lake at Marmion South, Central North, Anderson Dam and Lower Seine, and in Moose and Slush Lakes. Snow, Icy and Abie Lakes and Marmion South were sampled in early and late May and the remaining locations were sampled in late May, only.

Drift nets (or conical larval tow nets) were set in the channels between lakes of the cooling circuit. These nets were retrieved after 24 hours. Laboratory inspection of the samples revealed that they were highly decomposed. Consequently the results (numbers and species composition) of this aspect of the study are not reliable and are not included in this report. The decomposition was likely due to poor preservation or the length of the sets. In subsequent studies the nets will be emptied at least once during the 24-hour set.

Juvenile and forage fish were collected by beach seine hauls. Three hauls were made in each of May, August and October at each of the sampling areas.

Gill nets consisting of meshes ranging from 3.6 to 12.7 cm in 1.3 cm increments were set for approximately 2-hours during the late afternoon or evening in each of May, August and October at each of the ten sampling areas. Most walleye and northern pike were tagged and released and scale samples for ageing were taken from most walleye, northern pike, cisco and lake whitefish. The sampling schedule is summarized in Table 1.

4.0 RESULTS AND DISCUSSION

4.1 Temperature and Dissolved Oxygen

Temperature and dissolved oxygen profiles are listed in Appendix 1. In August the depth of the thermocline in the lakes with small surface areas (Snow, Icy, Abie and Slush Lakes) was approximately 5 m while the thermocline in Marmion Lake ranged

Table 1

Sampling Schedule - Atikokan 1985

	Snow. L.	Icy L.	Abie L.	Slush L.	Moose L.	Marmion L.				
						South	Central	North	Lower Seine	Anderson Dam
	MAO	MAO	MAO	MAO	MAO	MAO	MAO	MAO	MAO	MAO
Temp Profiles	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
D.O. Profiles	XX	XXX	XXX	XX	XXX	XXX	XXX	XXX	XXX	XXX
H_2O Chemistry	XXX	XXX	XXX	XXX		XXX		XXX		XXX
Macrophytes	X	X	X	X		X				X
Larval Tows	X	X	X	X	X	X	X	X	X	X
Beach Seines	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Gill Nets	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

Notes = All measurements in mg/L
S-Surface, B-Bottom
Pre-op - Mean of sampling from pre-operational phase (OHRD Report No. 86-38-K).
MAO - May, August, October

Note: May samples of some parameters are reported elsewhere (OHRD Report No. 85-333-K).

from 7 to 9 m (Table 2). In Moose Lake, the depth of the thermocline was below the intake at approximately 13 m. With the exception of Moose Lake the depth of the thermocline was similar to previous years. Removal of hypolimnetic water by the station's intake in Moose Lake and its replacement with epilimnetic water from Marmion Lake resulted in the relatively deep thermocline.

Table 2

Depth (m) of Thermocline and Depth of Oxygen Depletion ($\leq$ 2 ppm) at Atikokan August 7-9, 1985

Basin	Thermocline	O_2 Depletion
Snow Lake	5	6
Icy Lake	5	6
Abie Lake	5	6
Slush Lake	5	11
Marmion South	8	13
Marmion Central	8	-
Marmion North	7	12
Lower Seine	9	14
Anderson Dam	7	7
Moose Lake	13	33

As in previous years, hypolimnetic oxygen depletion was apparent in all of the lakes. In August, the depth at which oxygen concentrations dropped to 2 ppm or less ranged from 6 m in the shallow lakes (Snow, Icy and Abie) to 33 m in Moose Lake (Table 2). A lens (layer) of reduced oxygen concentrations was apparent in the area of the thermocline in Moose Lake (13-15 m). Oxygen concentrations at 12 m, 4.7 ppm, dropped to 2.9 ppm at 14 m before returning to 4.7 ppm at 16 m depth. On June 3, a similar lens of oxygen depletion was apparent from 12 to 17 m depth where oxygen concentration dropped from 9.7 to 7.7 ppm before rising to 8.2 ppm (Ontario Hydro Research Division Report

No. 85-333-K). This lens of lower oxygen concentrations suggests higher chemical or biological oxygen demand in the area of the thermocline of Moose Lake, perhaps due to accumulation of suspended particulates at the thermocline.

Additional information on the thermal regime of the cooling circuit for the study period is available in Ontario Hydro Design and Development Division - Generation Report No. 86308. Briefly, the results of that study indicated that surface water temperatures in the cooling circuit were similar among the lakes except when heated water was being discharged into Snow Lake. Thermal enrichment of surface waters in Snow, Icy and Abie Lakes was apparent at those times. The maximum recorded increases in the daily mean temperature of Snow, Icy and Abie Lakes and the outlet channel from Abie to Marmion Lakes were 4.8, 2.8, 2.4 and 2.1C° respectively. The maximum recorded surface temperatures recorded at those locations were 22.6, 23.7, 22.9 and 22.7C°, respectively.

4.2 Water Chemistry

Nutrients

Nutrient concentrations in water samples collected from the surface and bottom at eight locations in the cooling circuit are listed in Table 3. Generally, the concentrations of total Kjeldahl nitrogen and total and soluble phosphorus are reasonably consistent with measured concentrations during the pre-operational phase. Nitrate levels, however, were relatively low compared to the pre-operational means.

Lower Basin

Chemical analysis of surface water samples collected at three locations of the Lower Basin of Moose Lake are listed in Table 4. Waste commissioning fluids are discharged into the Lower Basin.

There was a trend toward higher dissolved solids and iron and lower pH near the mouth of the discharge stream. A similar trend for iron was also observed prior to initial discharge (January 1984). A trend of higher copper levels toward the discharge stream observed in May 1985 was not apparent in the present data.

Copper levels were lower than observed in May 1985 while nickel levels were slightly higher.

Table 3

Nutrient Analysis of Surface and Bottom Water Samples
Atikokan, August & October, 1985

Location		Total Kjeldahl Nitrogen			Nitrate			Total Phosphorus			Soluble Phosphorus		
		Aug	Oct	Pre-op	Aug	Oct	Pre-op	Aug	Oct	Pre-op	Aug	Oct	Pre-op
Snow L.	S	0.34	0.35	0.35	<0.01	0.06	<0.24	0.006	0.032	0.014	<0.005	0.007	<0.006
	B	0.39	0.30	0.33	<0.01	0.06	<0.58	0.007	0.016	0.024	<0.005	0.011	<0.006
Icy L.	S	0.34	0.39	0.39	<0.01	0.04	<0.13	<0.005	0.019	0.015	<0.005	0.010	<0.007
	B	0.40	0.39	0.44	<0.01	0.05	<0.20	0.016	0.020	0.028	0.009	0.007	<0.008
Abie L.	S	0.40	0.31	0.30	<0.01	0.06	<0.85	0.006	0.027	<0.014	<0.005	0.006	<0.005
	B	0.36	0.41	0.35	<0.01	0.06	<0.13	0.008	0.119	0.018	<0.005	0.006	<0.006
Slush L.	S	0.37	0.36	0.30	<0.01	<0.01	<0.39	0.005	0.014	<0.008	<0.005	<0.005	<0.004
	B	0.41	0.35	0.32	<0.01	<0.01	<0.37	0.015	0.013	0.020	<0.005	0.005	<0.007
Marmion L. South	S	0.34	0.36	0.29	<0.01	0.07	<0.39	0.007	0.034	<0.011	<0.005	0.009	<0.006
	B	0.29	0.29	0.27	<0.01	0.07	<0.29	0.009	0.030	<0.014	<0.005	0.007	<0.007
Marmion L. North	S	0.29	0.36	0.31	0.02	0.11	<0.20	0.011	0.029	<0.012	<0.005	0.009	<0.005
	B	0.28	0.37	0.30	<0.01	0.11	<0.31	0.006	0.026	<0.014	<0.005	0.007	<0.007
Anderson Dam	S	0.33	0.36	0.38	<0.01	<0.01	<0.07	0.010	0.027	<0.018	0.008	0.007	<0.007
	B	0.35	0.31	0.31	<0.01	<0.01	<0.43	0.013	0.024	0.024	<0.005	0.007	<0.010
Moose Lake	S	0.36	0.36	NS	<0.01	0.03	NS	0.008	0.015	NS	<0.005	<0.005	NS
	B	0.29	0.27	NS	0.56	0.03	NS	0.005	0.010	NS	<0.005	<0.009	NS

Notes = All measurements in mg/L
S-Surface, B-Bottom
Pre-op - Mean of sampling from pre-operational phase (OHRD Report No. 86-38-K).
NS - Not Sampled

Table 4

Chemical Analyses of Lower Basin Water Samples

Location	August 1985 1	2	3	$\bar{X}$	October 1985 1	2	3	$\bar{X}$	May 1985 $\bar{X}$	Jan 1984 $\bar{X}$
pH	ND	ND	ND	ND	7.0	7.2	7.3	7.2	7.4	7.2
Total Dissolved Solids (105°C)	ND	ND	ND	ND	326	160	145	210	ND	ND
Suspended Iron	ND	ND	ND	ND	0.083	0.051	0.039	0.058	ND	ND
Dissolved Iron	ND	ND	ND	ND	1.36	0.18	0.18	0.57	ND	ND
Total Iron	ND	ND	ND	ND	1.44	0.23	0.22	0.63	0.27	0.52
Copper	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.003
Nickel	<0.005	<0.005	<0.005	<0.005	0.006	0.006	0.006	0.006	<0.005	<0.005

Notes:

Locations - 1 - outfall of discharge stream
2&3 - along a transect from discharge stream to centre of basin
All measurements as mg/L except pH.
ND - not determined.
January 1984 sampling was before discharging of wastes; the remaining samples were following the first liquid discharge.

4.3 Macrophytes

4.3.1 Species Composition

A total of 41 macrophytes and one charophyte was observed in the study area in 1985 (Table 5). Thirty-five of the macrophyte species were submergents and floating-leafed, and six were emergent forms. The scientific and common names of the macrophytes are listed in Appendix 2.

The macrophytes that were widespread, occurring in at least four out of the five study lakes, were the submergents Elodea canadensis (waterweed), Myriophyllum exalbescens (water milfoil), Najas flexilis (bushy pondweed), Potamogeton amplifolius (large-leaf pondweed), P. epihydrus (leafy pondweed), P. richardsonii (clasping-leaf pondweed), P. robbinsii (Robbins pondweed), and Sagittaria spp (arrowhead), the floating-leafed Nymphaea odorata (water lily) and the emergent Typha spp (cattail).

Of the submergents, Elodea canadensis, Myriophyllum exalbescens, Najas flexilis, Potamogeton amplifolius, P. richardsonii, and P. robbinsii are generally considered typical of hard water habitats and P. epihydrus of low alkalinity habitats (Hutchinson 1975). With the exception of P. amplifolius and P. robbinsii, the species typical of hard water were not present in Slush Lake. During the preoperational study, mean annual pH (bottom) and hardness were lower in Slush Lake than in the remaining lakes (Ontario Hydro Research Division Report No. 86-38-K). Vertical pH profiles taken in June, 1985 indicated that the mean pH of the water column was lowest in Slush Lake (mean pH = 7.2).

As in the preoperational study, the lowest number of taxa (9) was found in Slush Lake. Higher numbers of taxa were observed in Icy (29) and Marmion Lakes (29) than in the remaining study lakes. During the preoperational study, the largest number of species was generally found in Marmion Lake.

The changes in species numbers recorded for the individual lakes between the preoperational studies and 1985 are in part due to sampling design (differences in sampling efficiency). Species of low abundances can easily be missed in a qualitative survey. However, the increase in species number in Icy and Abie Lakes may be indicative of a real increase in diversity with seven new records for Icy Lake and eight for Abie Lake. In the case of Abie Lake, diversity increased between 1982-1983 and 1985; species diversity had been relatively high in 1981.

Table 5

SPECIES OF MACROPYTES OBSERVED IN THE ATIKOKAN STUDY LAKES DURING THE PREOPERATIONAL SURVEYS

	Snow				Icy				Abie				Slush				Marmion			
Year	81	82	83	85	81	82	83	85	81	82	83	85	81	82	83	85	81	82	83	85
Macrophytes:																				
Beckmannia syzigachne (Steud.) Fern, e[1]																				
Brasenia schreberi Gmel., e									X	X	X	X					X			
Calamagrostis canadensis (Michaux) Beauv., e																		X		
Callitriche hermaphroditics L., s			X		X	X	X	X									X	X	X	X
C. heterophylla Pursh., s																	X	X		
Ceratophyllum demersum L., s			X														X	X	X	X
Dulichium arundinaceum (L.) Britton, e										X				X						
Eleocharis acicularis (L.) R. & S., s			X		X				X	X							X	X		X
E. paulustris (L.) R. & S., e									X								X		X	
Elodea canadensis (Michx.) Rich., s	X	X	X	X	X	X	X	X	X			X	X				X	X	X	X
Equisetum sp.,e	X					X			X								X			
Eriocaulon septangulare With., s	X																			
Glyceria borealis (Nash) Batch., f			X					X		X	X							X	X	X
Glyceria canadensis, s												X								
G. grandis S. Watson, e														X	X		X	X		X
Hippurus vulgaris L., e														X	X					X
Isoetes spp.,s				X								X								
Juncus effusus L., e									X											X
Lemna sp., f			X											X						
Lobelia dortmanna L., e	X																			
Megalodonta beckí,s								X				X								
Mimmulus ringens L., e									X								X			
Myriophyllum alterniflorum D.C., s	X					X		X			X	X					X	X	X	X
M. exalbescens Fern., s	X		X	X	X	X	X	X	X	X	X	X					X	X	X	X
Najas flexilis (Wild.) Rostk, & Schmidt, s	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Nuphar sp., f	X				X			X	X	X	X	X	X	X	X	X				
Nymphaea odorata Ait., f	X				X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Nymphaea tetragona, f												X								
Polygonum natans Eat., f								X	X	X	X	X				X		X		
Potamogeton alpinus Balbis, s,f				X														X		
P. amplifolius Tuckerm., s	X		X	X				X	X				X		X	X	X	X	X	X
P. epihydrus Raf., s,f	X	X	X	X		X		X				X	X	X	X	X	X	X	X	X
P. foliosus Raf., s		X	X	X			X	X										X	X	
P. friesii Rupr., s						X		X			X									
P. gramineus L., s,f	X						X		X	X	X	X					X		X	X
P. natans L., s,f							X	X				X					X	X		X
P. obtusifolius Mert & Koch., s		X	X	X				X												
P. pectinatus L., s							X										X			
P. praelongus Walfen., s					X			X									X		X	X
P. pusillus L., s	X		X	X	X			X					X				X	X		X
P. richardsonii (Benn.) Rydb., s	X		X	X		X	X	X	X		X	X			X		X	X	X	X
P. robbinsii Oakes., s	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
P. spirillus Tuckerm., s,f					X												X	X	X	X
P. strictifolius Benn., s					X	X		X				X								
P. vaseyi Robbins, s,f													X							
P. zosteriformis Fern., s				X			X	X	X								X	X	X	X
Ranunculus tricophyllus Chaix., s	X	X	X	X	X	X	X	X	X		X						X	X	X	X
Rorippa islandica (Oeder.) Borbas, s									X								X			
Sagittaria spp. e,s	X		X			X	X	X	X	X	X	X			X	X	X	X	X	X
Scirpus cyperinus (L.) Kunth., s			X	X				X						X	X		X	X		X
Sium suave Walt., e									X	X		X					X			X
Sparganium fluctuans (Morong.) Robinson, f	X							X				X								X
Typha spp., e		X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X
Utricularia vulgaris L., s	X				X			X	X	X	X	X	X				X	X		
Vallisneria americana Michx., s	X		X			X	X	X	X	X	X					X		X		
Charophytes:																				
Chara sp., s	X	X	X	X	X	X	X		X	X	X	X					X			X
unidentified Charophytes, s			X														X		X	
Total Number of Species	21	9	22	17	15	17	17	29	25	17	18	24	10	11	12	9	34	30	21	29

[1] The letter(s) following the taxonomic binomials refers to the growth form of the species; e - emergents, f - floating leafed, s - submergent

4.3.2 Distribution and Abundance of Macrophytes

Generally, with the exception of Slush Lake, the distribution, abundance and species diversity of the macrophytes in the study lakes has increased between 1983 and 1985.

Snow Lake

The macrophyte community of Snow Lake was exceptional compared to those of the remaining lakes in respect to the absence of the water lilies, Nymphaea odorata and Nuphar sp, and in the predominance of Elodea canadensis. Both water lilies were present in 1981 before the water level was lowered in 1982. Loss of habitat due to lowered water levels as well as increased currents from the discharge may have prevented the recolonization of these species.

With the increase in the abundance of Elodea canadensis observed between 1982 and 1983, (Ontario Hydro Research Division Report No. 85-81-K) there was concern that this species would continue to proliferate following commissioning of the generating station as was found at the Wabamun Generating Station (Haag and Gorham, 1977). At that generating station the increased biomass and distribution of Elodea canadensis resulted in interference with recreational amenities.

The macrophyte cover and abundance in Snow Lake had increased somewhat over that of 1983 although the distribution was quite similar. Generally, dense cover and diversity was found in the protected bays and indented areas along all of the shoreline except the southwestern stretch, where the vegetation was sparse (Figure 3). As in 1983, large stretches of the emergent forms, Typha spp and Scirpus cyperinus (bulrush) were found in the areas exposed during the water level drawdown in 1982. Najas flexilis was the most common submergent along the north shore while Elodea canadensis was the most common submergent along the southeast shore and in the northwest bay, the area selected for detailed study.

In the northwest bay the area of macrophyte cover had spread to the east and to the south of the cover area observed in 1983 (Figures 4 and 5). Density (% cover) was generally lowest at the southwest end of the bay, near the discharge at transect 4 and was highest in the center of the bay. The density of submergent macrophytes had increased along the first 40 m of transects 2 and 3 from 25% cover in 1983 to 80% cover in 1985.

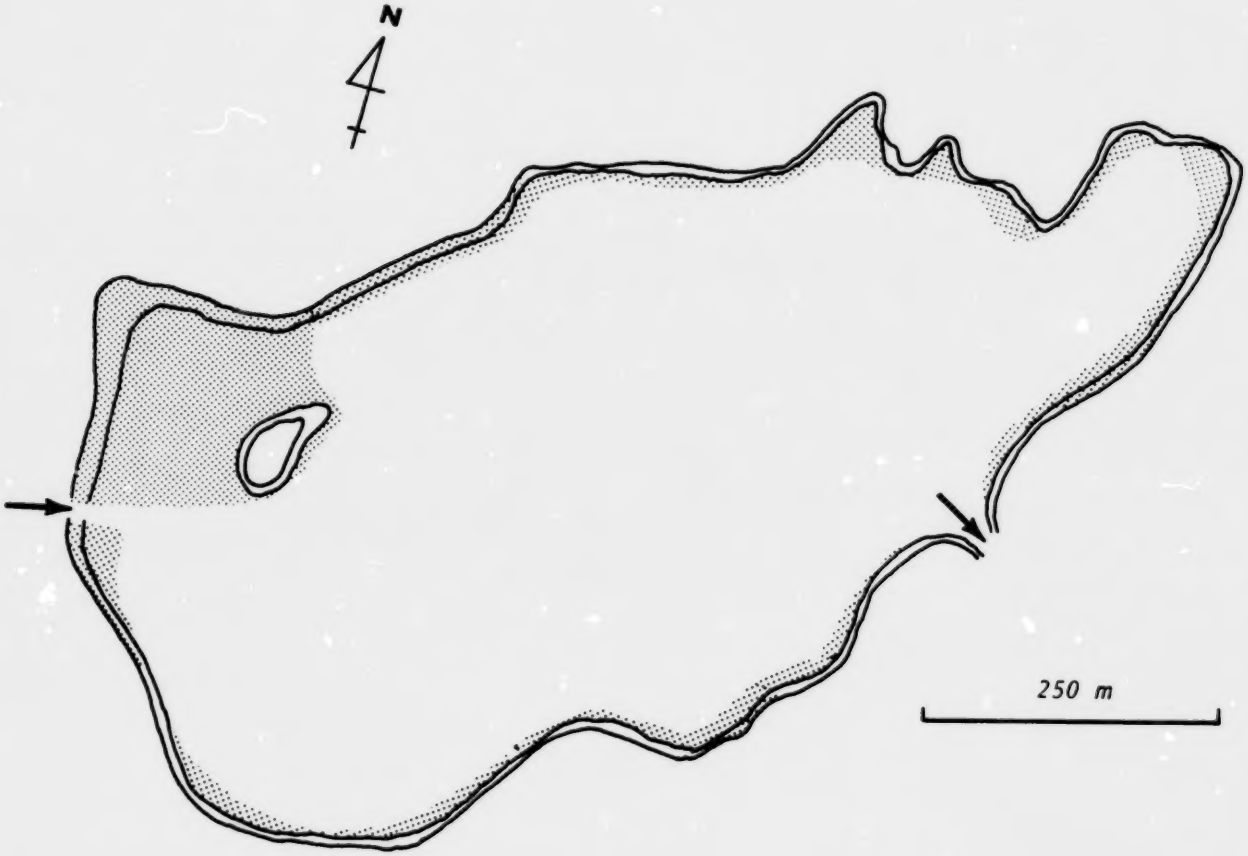


FIGURE 3
DISTRIBUTION OF MACROPHYTES IN SNOW LAKE IN 1985

FIGURE 4
DISTRIBUTION OF MACROPHYTES ALONG
WEST SHORE OF SNOW LAKE IN 1985

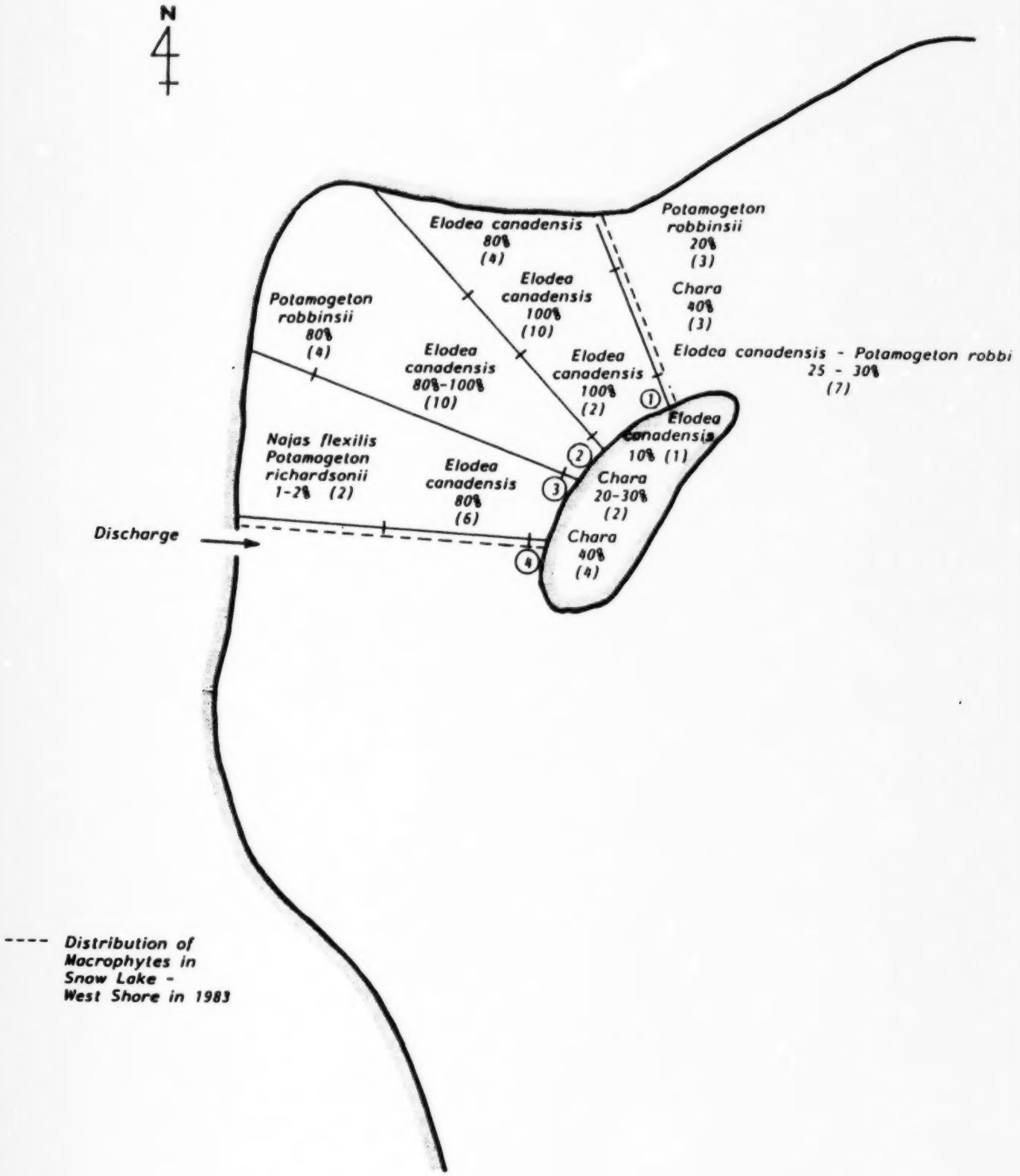


FIGURE 5

DOMINANT SUBMERGENT MACROPHYTES (≥50%), PERCENT COVER OF SUBMERGENT MACROPHYTES, AND NUMBER OF SUBMERGENT MACROPHYTE SPECIES ( ) ON TRANSECT SEGMENTS (⊢⊣) ALONG WESTERN SHORE OF SNOW LAKE, 1985

174689-R

The species diversities along transects 1, 2 and 4 (Appendix 3) had also increased over those recorded in 1983 (Appendix 3). Elodea canadensis was the predominant submergent form along transect 2 and the areas of densest growth on transects 3 and 4. Other species that were among the more common submergents were Potamogeton robbinsii, Najas flexilis and Chara spp. In 1983, P. pusillus, rather than P. robbinsii, along with Elodea canadensis and Najas flexilis were the most common submergent macrophytes in this bay.

Icy Lake

The West Bay

The typical temperature zonation pattern of emergent, floating-leafed to submergent macrophyte dominance with distance from shore was obvious in this bay. The distribution of submergent macrophytes had increased over that observed in 1983, with growth extending further east at the mouth of the bay in 1985 (Figures 6 and 7).

As in 1983, the most abundant emergent form in the west bay was Typha spp and the most common floating-leafed species was Nymphaea odorata.

Generally, as in 1983, Potamogeton robbinsii was the most widespread and abundant submergent in the bay. P. robbinsii and P. richardsonii were the most common species in areas where cover was highest along transects 5 and 6, and along the north end of transect 7. Megalodonta beckii was the most common submergent macrophyte in the north arm of the bay along transects 1,2 and 3. Myriophyllum exalbescens was the most prominent species on transect 7. Megalondonta beckii, absent from the preoperational study species list, had been lumped with Myriophyllum exalbescens in 1983 and was only distinguished as being distinct from that species during the 1985 field program.

A substantial increase in the number of species was observed on transect 5, from 5 in 1983 to 11 in 1985.

East Bay

The large patches of vegetation present in 1983 were observed in the northeast half of the bay in 1985 (Figure 8 and 9). In the southwest half of the bay, the abundance and distribution of macrophytes had increased substantially over that found in 1983, especially along transects 14 and 15.

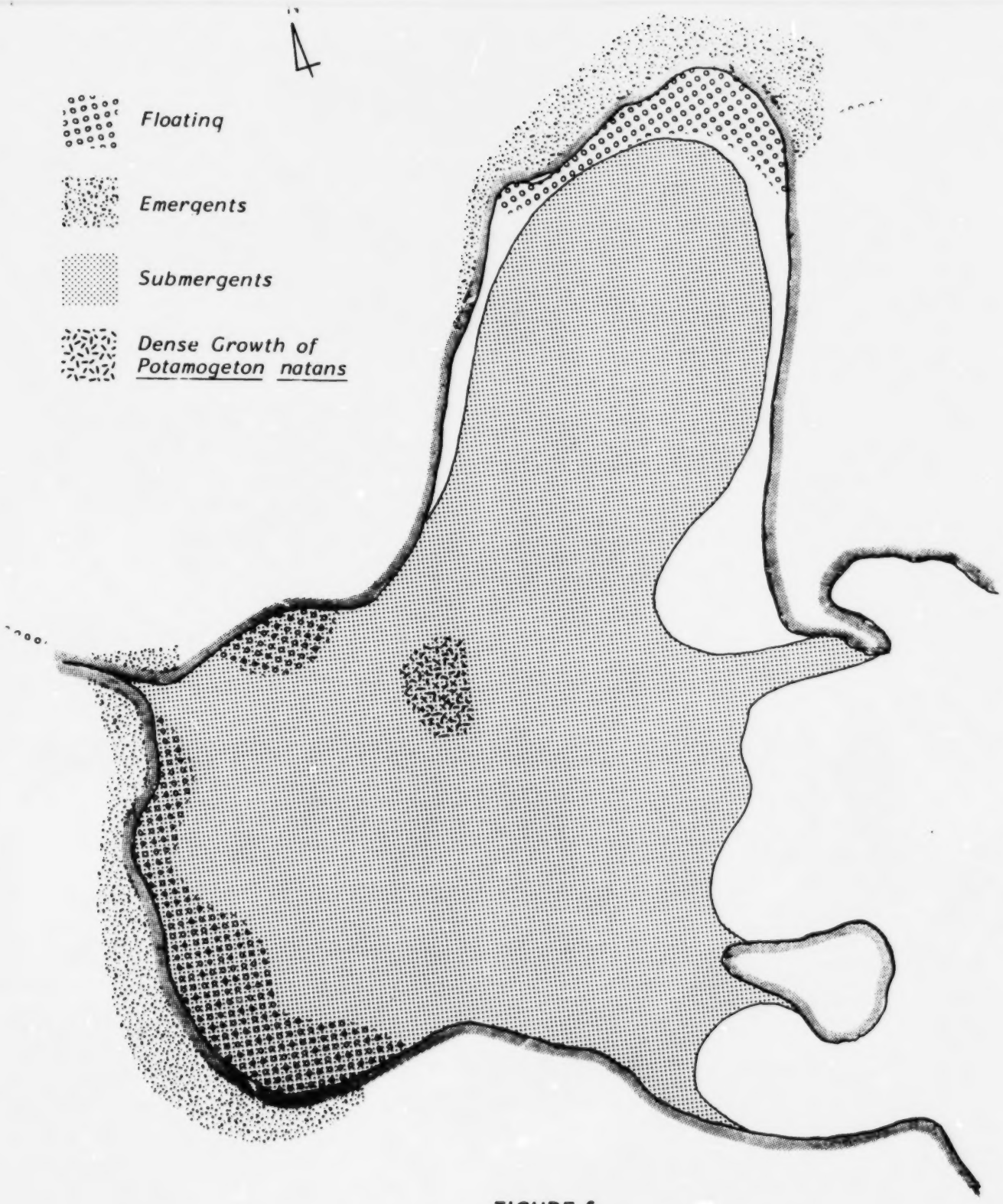


FIGURE 6

DISTRIBUTION OF MACROPHYTES IN WEST BAY
OF ICY LAKE IN 1985

87-233
174690-RD

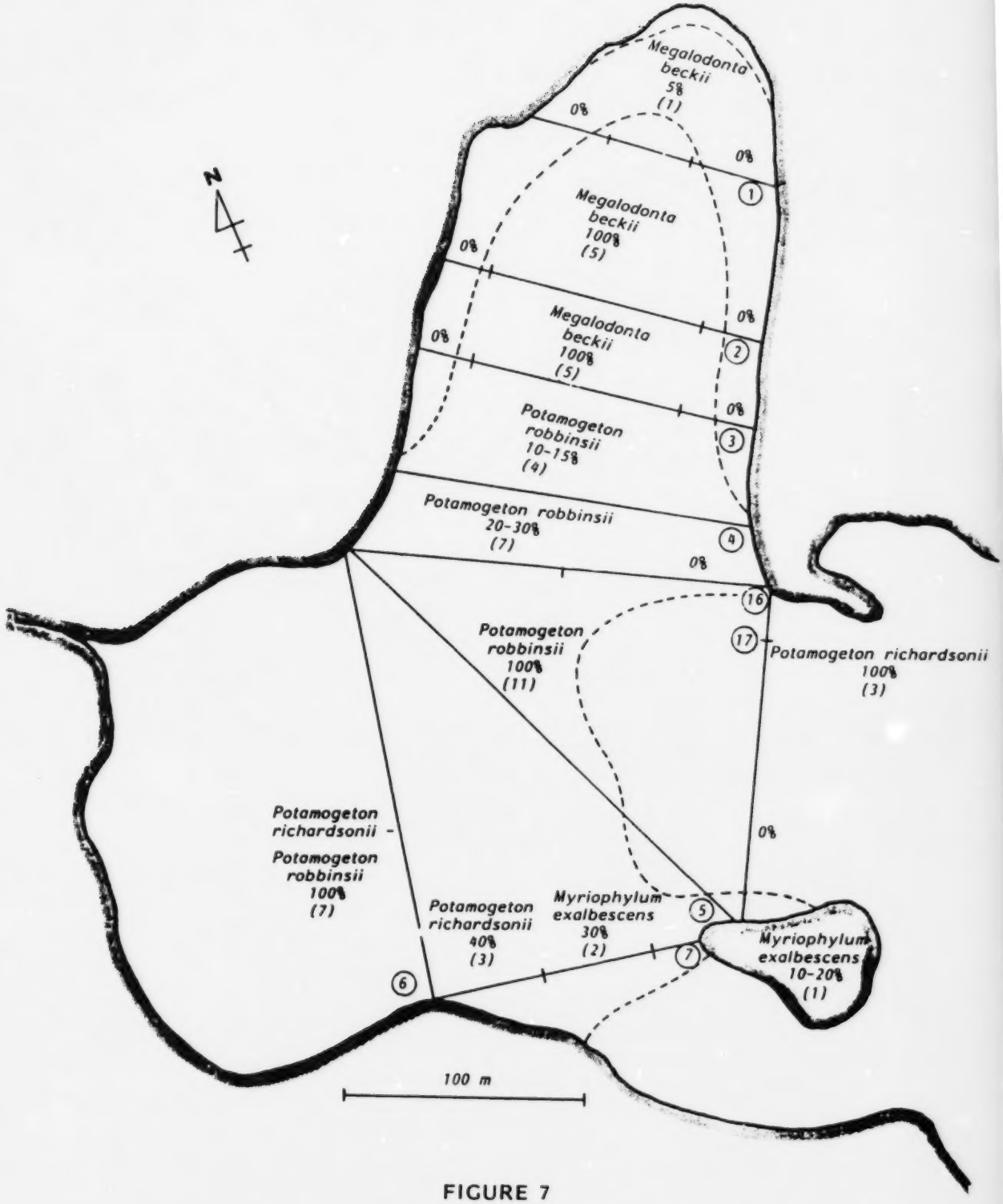


FIGURE 7

ICY LAKE - WEST BAY

DOMINANT SUBMERGENT MACROPHYTES (≥50%), PERCENT COVER OF SUBMERGENT MACROPHYTES, AND NUMBER OF SUBMERGENT MACROPHYTE SPECIES ( ) ON TRANSECT SEGMENTS (+—+) IN WEST BAY OF ICY LAKE, 1985

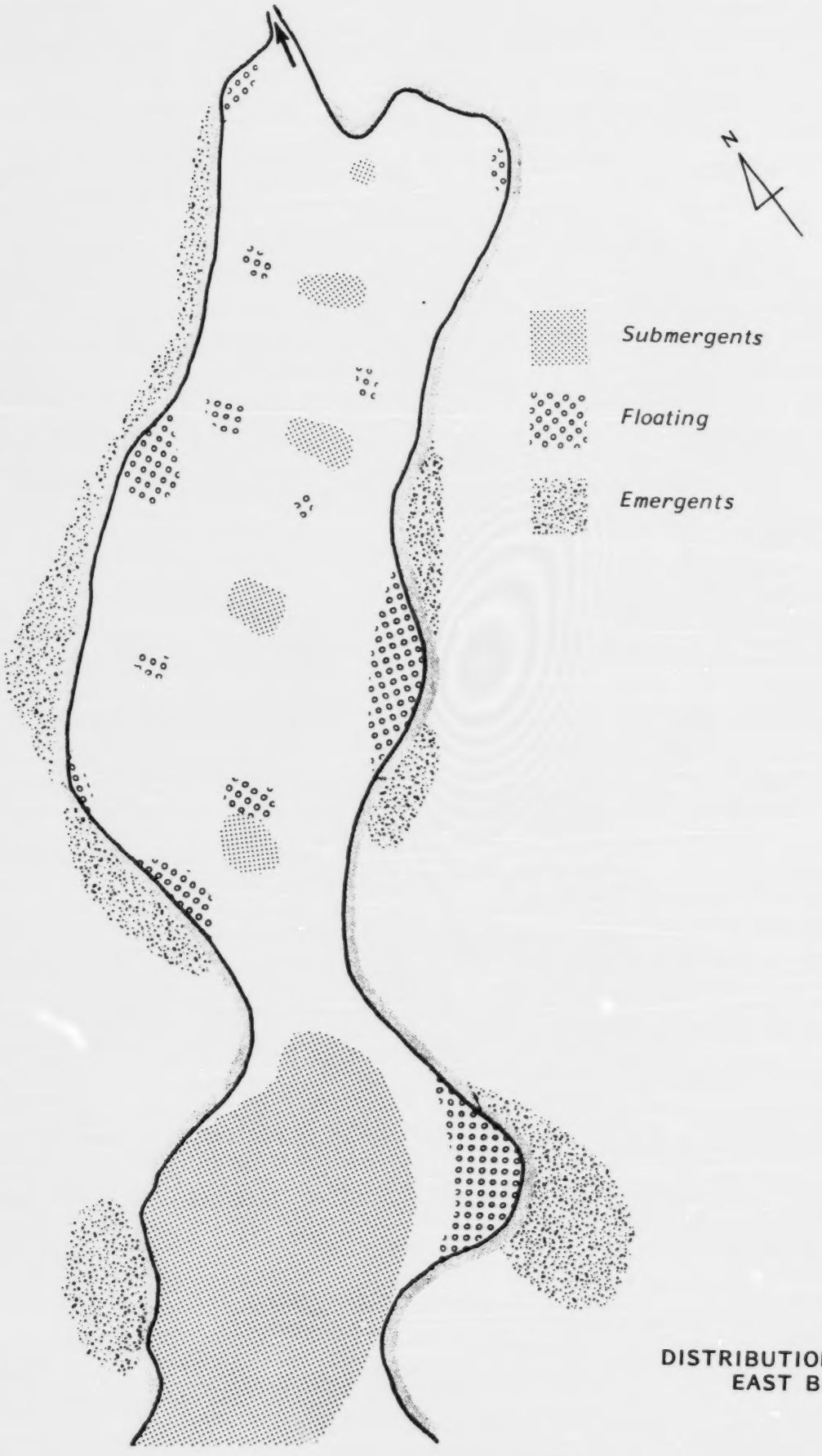


FIGURE 8
DISTRIBUTION OF MACROPHYTES IN
EAST BAY OF ICY LAKE
IN 1985

174692-RD

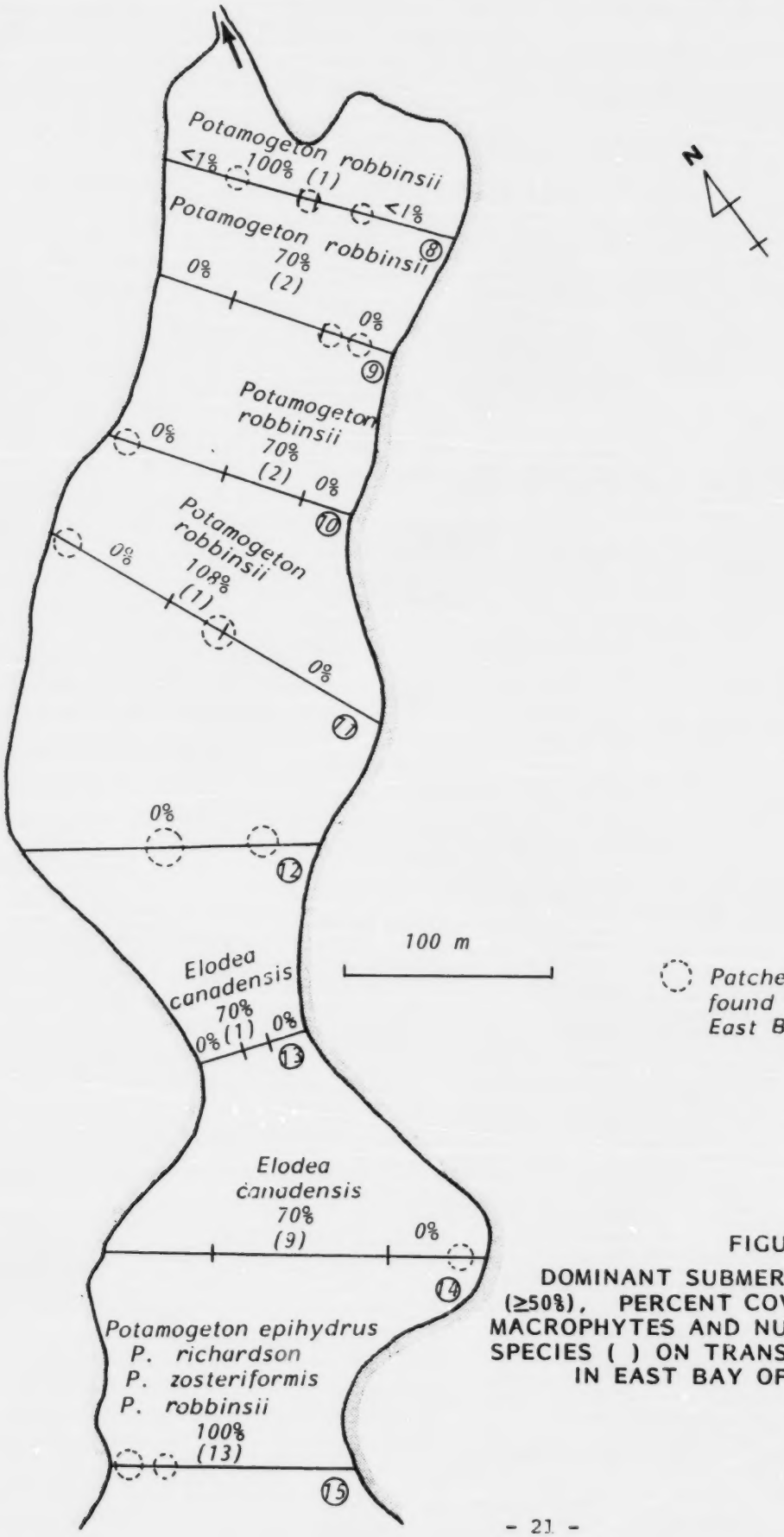


FIGURE 9

DOMINANT SUBMERGENT MACROPHYTES (≥50%), PERCENT COVER OF SUBMERGENT MACROPHYTES AND NUMBER OF SUBMERGENT SPECIES ( ) ON TRANSECT SEGMENTS (⊢⊣) IN EAST BAY OF ICY LAKE, 1985

174693-RD
87-233

Potamogeton robbinsii was the predominant submergent on the eastern transects (transects 8, 9, 10 and 11). Elodea canadensis, absent from the transects in 1982 and 1983, was found on transects 13, 14 and 15. Clumps of Elodea canadensis were found along the middle section of transect 13 and it was the most abundant species along the area of dense vegetation on transect 14. The vegetation had declined in the east bay of Icy Lake between 1982 and 1983. It was suggested that lower water levels in Icy Lake may have resulted in substantial winter kill and the consequent reduction in macrophytes observed (Ontario Hydro Research Division Report No. 85-81-K). The successful recolonization by Elodea canadensis may be due to the adaption it has for spreading by vegetative means described in the Atikokan GS preoperational summary report (Ontario Hydro Research Division Report No. 86-38-K). The stems of this species are easily broken and readily form adventitious roots (St. John 1965). With the predominance of Elodea canadensis in Snow Lake, this species could easily spread downstream in the discharge water circuit.

A substantial increase in the number of species between 1983 and 1985 was observed on transects 14 (from 4 to 9) and transect 15 (from 3 to 13) while a reduced number were observed on transects 8 (from 8 to 1), 11 (from 7 to 1) and 12 (from 5 to 0). Transects 14 and 15 are in the area of the bay where cover had increased since 1983. The heterogeneity in this area may have been a consequence of disturbance which resulted in remnants of the previous submergent community coexisting with new colonizers as hypothesized for Snow Lake in 1982 (Ontario Hydro Research Division Report No. 86-38-K). Potamogeton epihydrus, P. richardsonii, P. zosteriformis, and P. robbinsii were the most common species along transect 15, in the recolonized area.

Increases in the distribution and abundance of macrophytes can result in increased siltation (Sculthorpe 1967). This was apparent in the east bay of Icy Lake.

Abie Lake

Vegetation in the east basin of Abie Lake occurred throughout the basin with the exception of a short section off the east shore, at the offshore end of transect 3 (Figure 10). The distribution of macrophytes in the basin has increased slightly over the 1983 distribution (Figure 11), spreading to the open ends at the northeast and northwest of the basin.

The typical zonation of emergent, floating-leafed to submergent macrophytes with distance from shore was obvious along all

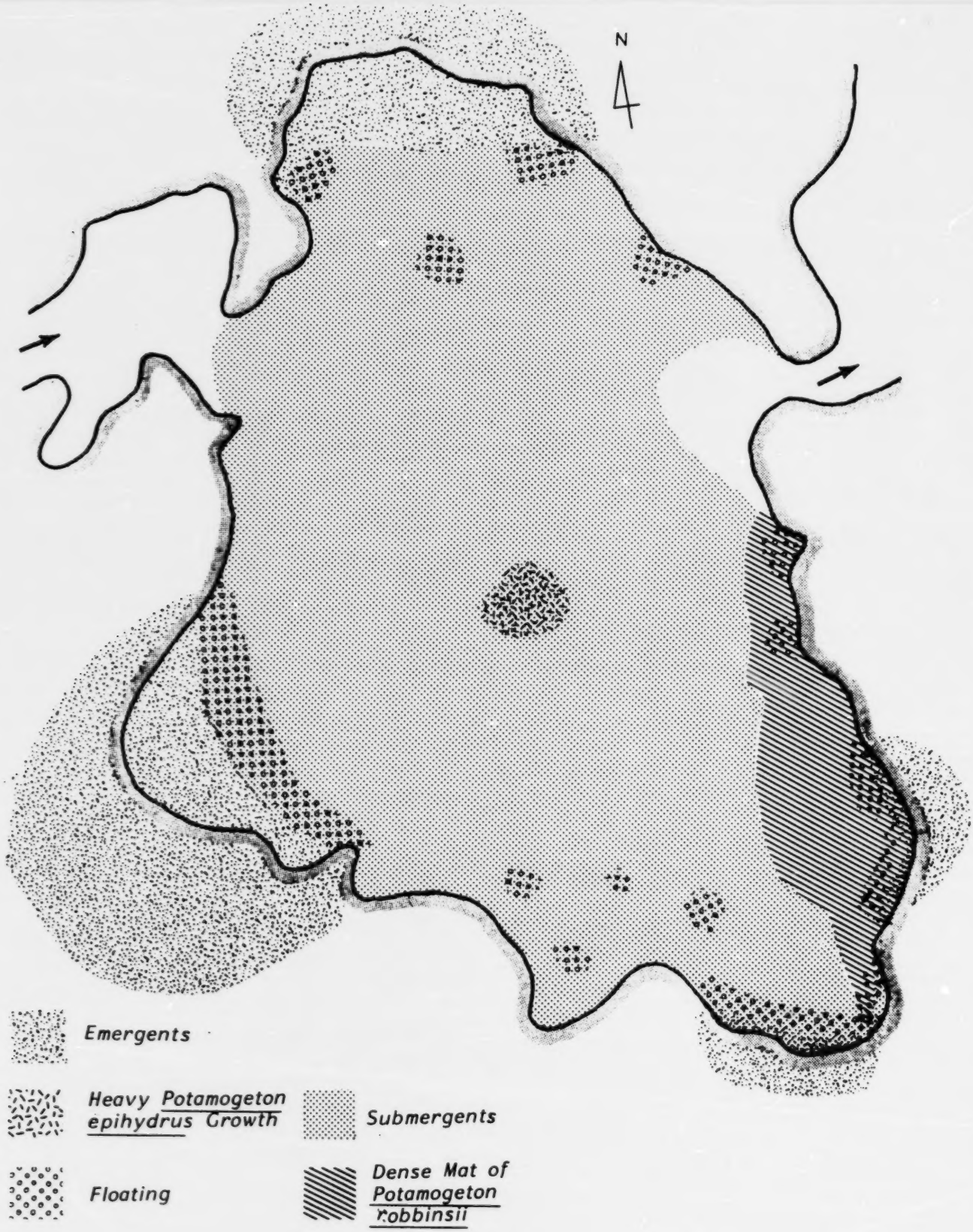


FIGURE 10

DISTRIBUTION OF MACROPHYTES IN EAST BASIN OF ABIE LAKE IN 1985

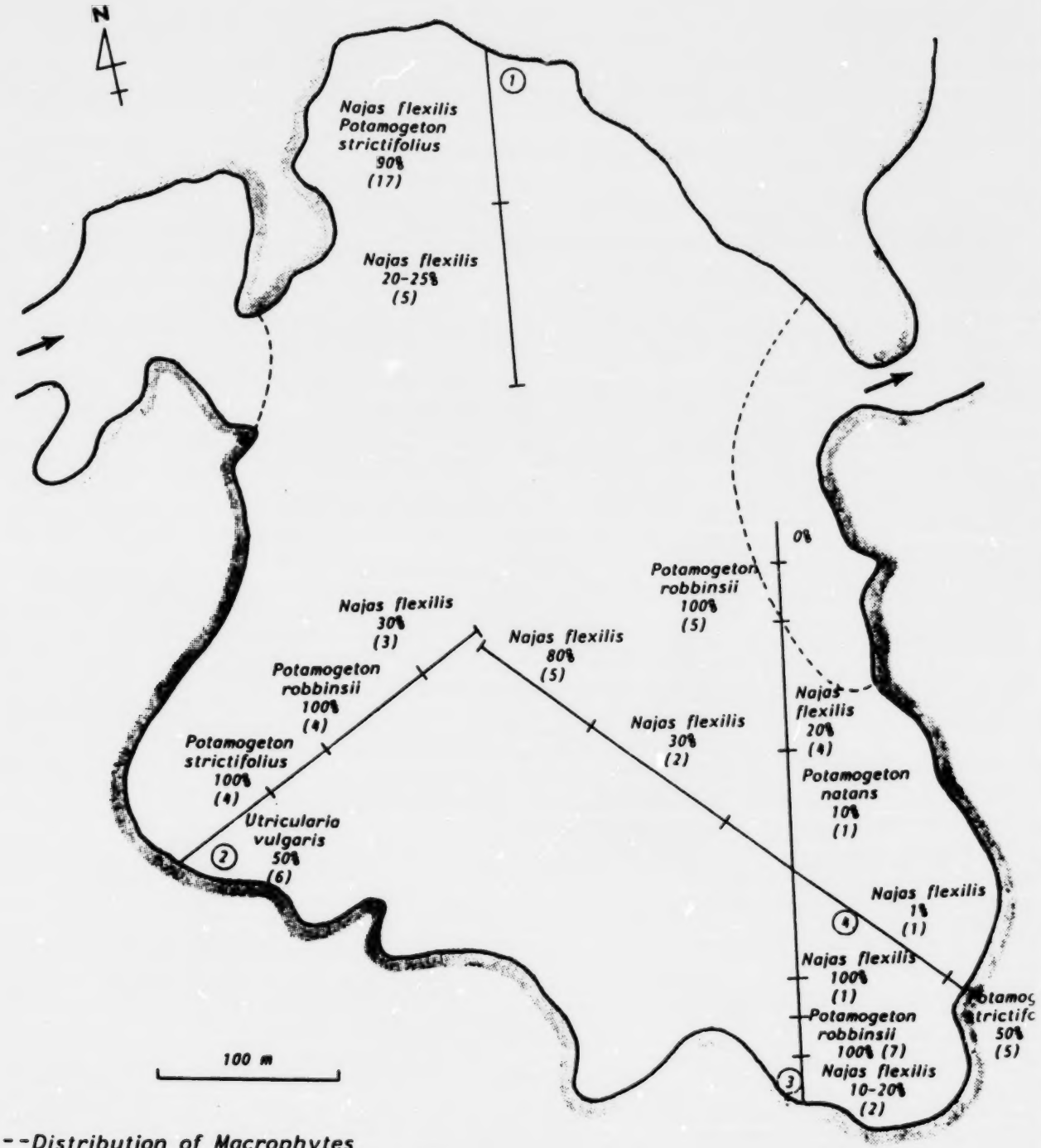


FIGURE 11

DOMINANT SUBMERGENT MACROPHYTES (≥50%), PERCENT COVER OF SUBMERGENT MACROPHYTES, AND NUMBER OF SUBMERGENT MACROPHYTE SPECIES ( ) ON TRANSECT SEGMENTS (+—+) IN EAST BASIN OF ABIE LAKE, 1985

transects. Typha spp was the most common emergent and Nymphaea odorata the most common floating-leafed species.

The most common submergent macrophyte in the east basin of Abie Lake was Najas flexilis. The abundance of this species had decreased between 1982 and 1983 (Ontario Hydro Research Division Report No. 86-38-K). Najas flexilis is among the vegetation described as choice duck food (Fassett 1975). Other macrophytes that were among the more common submergent forms were Potamogeton robbinsii, P. strictifolius, P. natans and Utricularia vulgaris.

The number of species identified in the east basin of Abie Lake in 1985 (24), although comparable to the number of species found in 1981 (25), was substantially higher than those found in 1982 (17) and 1983 (18). The drop in species numbers between 1981 and the subsequent two years was attributed to a change in sampling method. Sampling has been constant since 1982. Thus the increase in species number in 1985 may in fact be an indication of increased diversity. The increased species diversity was especially obvious on transect 1, with an increase of species from 9 in 1983 to 20 in 1985.

Slush Lake

As in the preoperational study, the growth of macrophytes in Slush Lake was sparse. It was characterized by occasional small patches of emergents, lilies and pondweeds along the shore (Figure 12).

The species composition was also similar to that in previous years with an extremely low number of species found. Most of the hard water species, which were widespread in the remainder of the study area (see Species Composition section) were missing from this lake. The most common macrophytes were the emergent, Typha spp, the floating-leafed, Nymphaea odorata and Nuphar sp, and the submergents, Potamogeton amplifolius and Sagittaria spp.

Marmion Lake

Because of poor visibility caused by high turbidity, the two areas selected for special study in Marmion Lake are the most difficult to describe and compare with previous years.

Near Abie Lake

Generally, it appears as though the vegetation cover did not extend as far offshore around transect 1 as it did in 1983

Floating

Emergents

Submergents

FIGURE 12
DISTRIBUTION OF MACROPHYTES IN
SLUSH LAKE IN 1985

(Figures 13 and 14). However, the distribution alongshore, around the island as well as the mainland, had extended beyond that recorded in 1983.

The typical temperate zonation pattern was observed on the island. Along the mainland, however, emergent forms were generally lacking.

The relative abundance of species on transect 2 could not be determined because of poor visibility. On transect 1, Potamogeton zosteriformis was the most common submergent on transect 3, Najas flexilis was the most common form near the island, Potamogeton richardsonii was the most common species near the mainland. Potamogeton zosteriformis and P. richardsonii were also among the most common species present in this area in 1983.

Near Anderson Dam

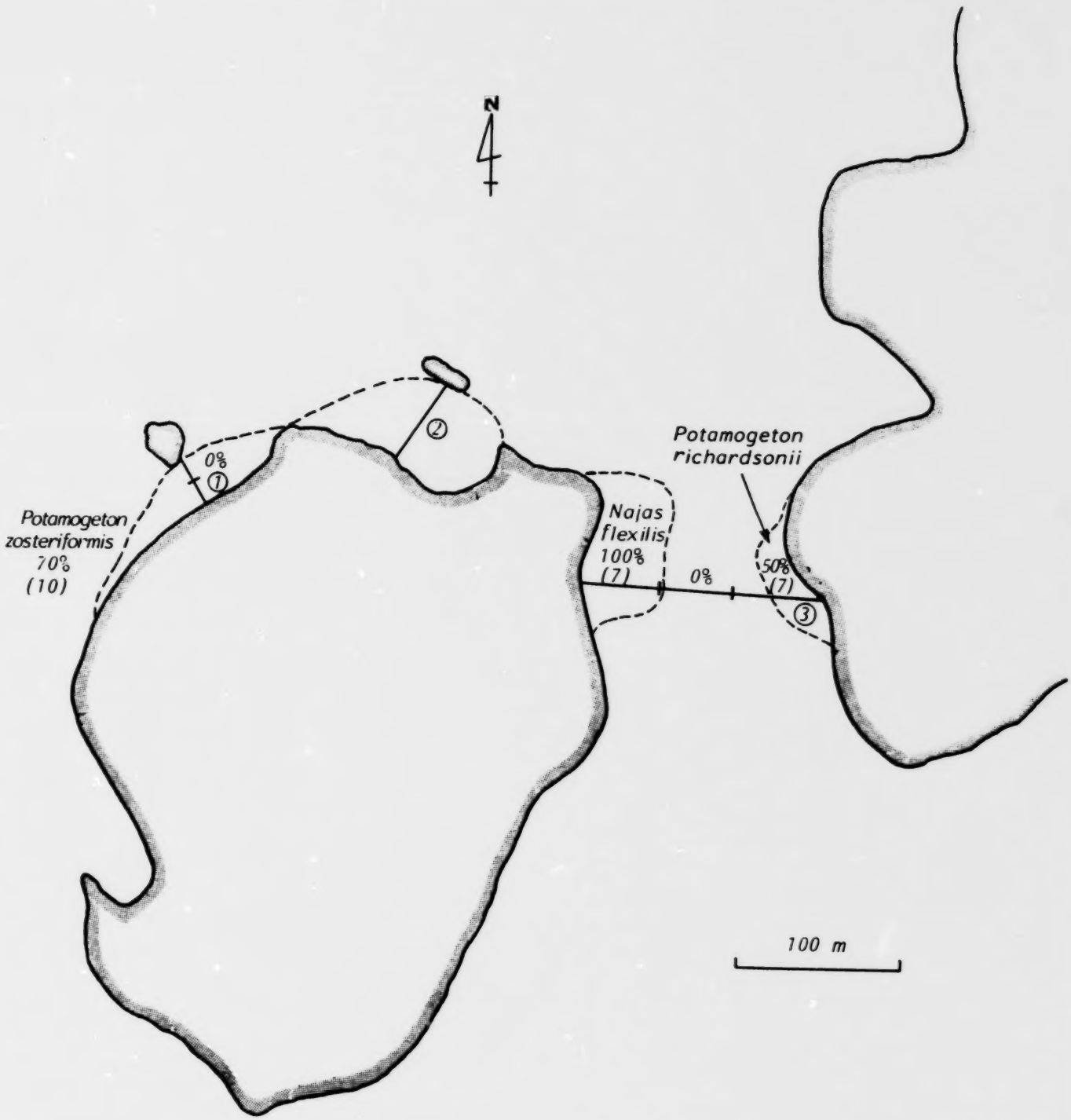
The vegetation distribution as well as abundance in this area had also increased over that observed in 1983. The growth extended further offshore around transects 1, 2 and 3, and alongshore around transect 4 (Figures 15 and 16). The percent cover on transect 1,2 and 3 had increased to 100% all along the transects. In 1983, areas of low cover were found along these three transects. Cover on transect 4 remained at 100% as in 1983.

The number of species found in this area (21) had increased over the number recorded in 1983 (16), especially on transect 4 (from 9 to 15). Potamogeton richardsonii, whose abundance had increased between 1982 and 1983, was the most common species found along transects 1 and 2. Relative abundance could not be determined along transect 3 due to low visibility. Myriophyllum exalbescens and Potamogeton gramineus were the most abundant species on transect 4. Both these species were common in this area in 1982 and 1983.

OVERVIEW

The most common and widespread macrophytes in the study area were the submergents, Elodea canadensis, Myriophyllum exalbescens, Najas flexilis, Potamogeton amplifolius, P. epihydrus, P. richardsonii, P. robbinsii, and Sagittaria spp, the floating-leafed Nymphaea odorata and the emergent Typha spp. Most of the common submergents were typical of hard water habitats and were not present in Slush Lake which had the lowest pH of the study lakes. The abundance and distribution of

FIGURE 13
DISTRIBUTION OF MACROPHYTES IN MARMION LAKE NEAR ABIE LAKE IN 1985



---- *Distribution of Macrophytes in Marmion Lake near Abie in 1983*

FIGURE 14

DOMINANT SUBMERGENT MACROPHYTES (≥50%), PERCENT COVER OF SUBMERGENT MACROPHYTES AND NUMBER OF SUBMERGENT SPECIES ( ) ON TRANSECT SEGMENTS (⊢⊣) IN MARMION LAKE NEAR ABIE LAKE - 1985

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FIGURE 15

DISTRIBUTION OF MACROPHYTES IN MARMION LAKE NEAR ANDERSON DAM IN 1985

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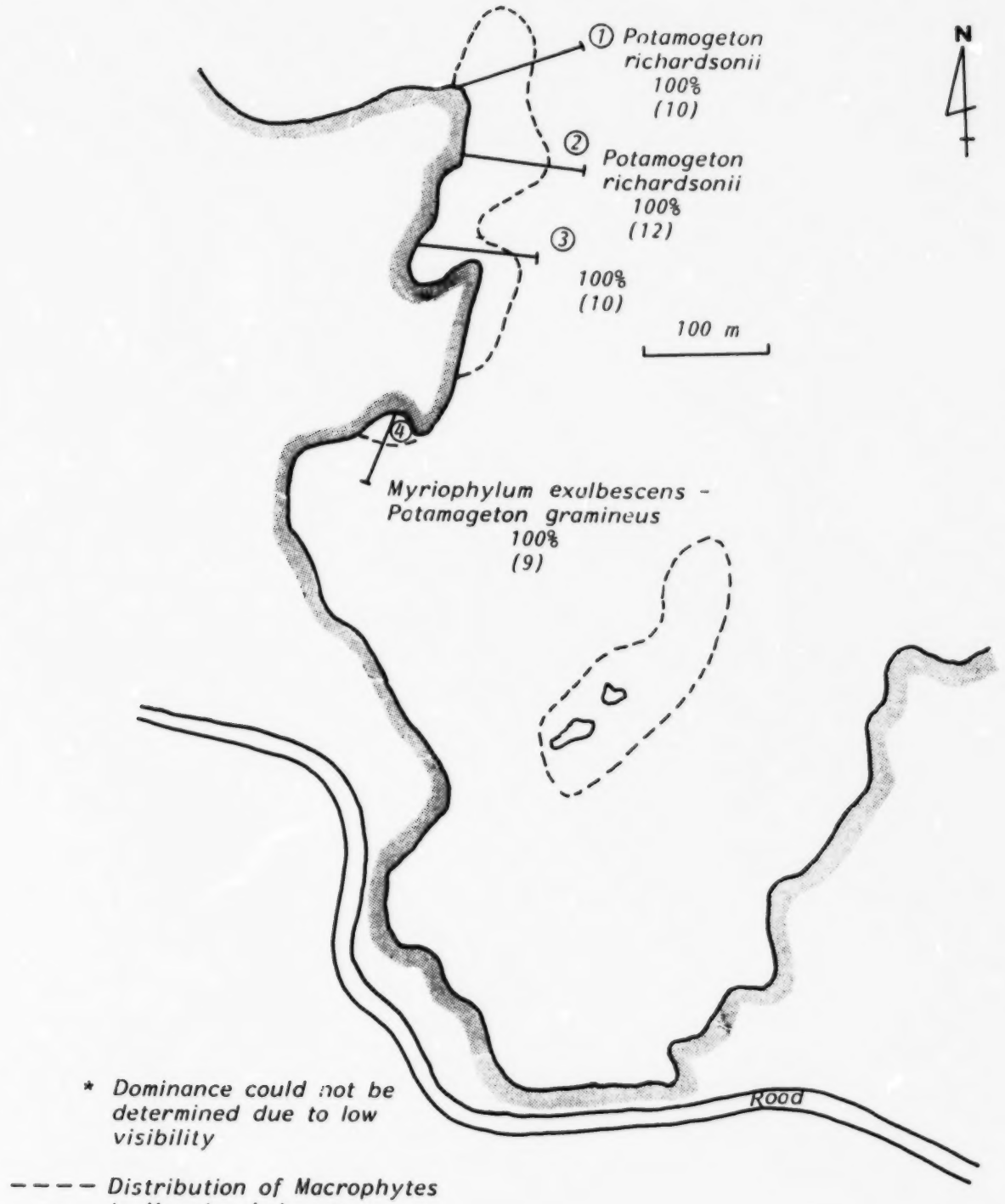
① Potamogeton richardsonii 100% (10)
② Potamogeton richardsonii 100% (12)
③ 100% (10)
④ Myriophylum exalbescens - Potamogeton gramineus 100% (9)
N
100 m
Road
* Dominance could not be determined due to low visibility
---- Distribution of Macrophytes in Marmion Lake at Anderson Dam in 1983

FIGURE 16

DOMINANT SUBMERGENT MACROPHYTES (≥50%), PERCENT COVER OF SUBMERGENT MACROPHYTES, AND NUMBER OF SUBMERGENT MACROPHYTES ( ) ON TRANSECT SEGMENTS (+—+) IN MARMION LAKE NEAR ANDERSON DAM, 1985

macrophytes in the areas selected for special study had increased over that recorded in the 1983 preoperational study.

The typical zonation pattern of emergent, floating-leafed to submergent forms with distance from shore was observed in all areas selected for detailed study except the west shore of Snow Lake. Generally, the most common emergent was Typha spp and the most common floating-leafed form was Nymphaea odorata. The floating-leafed lilies were not present in Snow Lake.

Elodea canadensis was the most abundant submergent macrophyte in the area selected for detailed study in Snow Lake. The abundance of this species had also increased over that observed in 1983 in the east bay of Icy Lake. Potamogeton robbinsii was also prominent in the east bay of Icy Lake and was the most common submergent species in the West Bay. Najas flexilis was the most abundant submergent macrophyte in the east basin of Abie Lake. Vegetation in Slush Lake was sparse. The most common submergents in this lake were Potamogeton amplifolius and Sagittaria spp. In Marmion Lake near Abie Lake the more common submergents were Potamogeton zosteriformis, Najas flexilis, and P. richardsonii. Near Anderson dam the main submergents were P. richardsonii, Myriophyllum exalbescens, and P. gramineus.

4.4 Fish

Larval Tows

Larval fish were collected in duplicate tow nets during May at several locations throughout the cooling cirucit. The results of these tows are in Appendix 4 and summarized in Table 6. Yellow perch and lake whitefish were the most commonly caught species in the larval tows. Yellow perch were caught in each basin while lake whitefish were collected in all basins except Slush Lake. In earlier studies (1981-1984) only one lake whitefish had been collected in Snow Lake. Yellow perch and Iowa darter were the most commonly collected larval fish in May 1981 (Ontario Hydro Research Division Report No 86-38-K), while yellow perch, cisco and lake whitefish were common in May 1983 (Ontario Hydro Research Division Report No 85-81-K).

Beach Seines

The catch in triplicate beach seine hauls conducted in May, August and October 1985 are listed in Appendix 5. A total of 1,872 fish representing 13 species were collected in beach seine hauls. Yellow perch (37.2%) and mimic shiner (23.7%) were the most frequently collected species over all locations (Table 7).

Table 6

Catch per Five-Minute Larval Tow, May 1985

Location	(n)	White Sucker	Lake Whitefish	Yellow Perch	Cisco	Gasterosteidae	Unidentified	All Species
Snow Lake								
Inlet[1]	(4)	0	0	0	0.75(13)[2]	0	0.25(4)	1.0(17)
Outlet	(4)	0	0.5(9)	1.25(21)	0	0	0	1.75(30)
Icy Lake								
Inlet	(4)	0	0	1.0(17)	0	0	0	1.0(17)
Outlet	(4)	0	0.5(9)	0.75(13)	0	0	0	1.25(21)
Abie Lake								
Inlet	(4)	0	1.5(25)	0.75(13)	0.25(4)	0	0	2.5(42)
Outlet	(4)	0.75(13)	0.25(4)	1.0(17)	1.0(17)	0	0	3.0(51)
Slush Lake	(2)	0	0	72.0(1220)	0	0	0	72.0(1220)
Marmion Lake								
South	(6)	0	1.17(20)	0.67(11)	0	0	0	1.84(31)
Central	(2)	0	6.5(110)	3.0(51)	0	0	0	9.5(161)
North	(2)	0	1.0(17)	0.5(9)	0	0	0	1.5(25)
Lower Seine	(2)	0	2.5(42)	2.0(34)	0	0	0	4.5(76)
Anderson Dam	(2)	0	0.5(9)	2.5(42)	0	0.5(9)	0	3.5(59)
Moose Lake	(2)	0	1.5(25)	4.0(68)	0	0	0	5.5(93)
Mean of All Locations		0.06(1)	1.22(21)	6.94(118)	0.15(3)	0.04(1)	0.02(0)	8.37(142)

[1] station discharge

[2] approximate density (No/1000 m^3)

Table 7

Number and Percent Composition of Fish Collected in Beach Seines, 1985

Species	Snow Lake	Icy Lake	Abie Lake	Slush Lake	Moose Lake	Marmion Lake					Total
						South	Central	North	Anderson Dam	Lower Seine	
Yellow Perch	50(38.8)	192(68.1)	23(9.7)	0(0.0)	20(10.8)	1(2.3)	1(12.5)	275(88.7)	78(19.8)	56(20.1)	696(37.2)
Mimic Shiner	25(19.4)	20(7.1)	178(74.8)	0(0.0)	114(61.6)	6(13.6)	1(12.5)	1(0.3)	82(20.8)	16(5.7)	443(23.7)
Iowa Darter	49(38.0)	4(1.4)	7(2.9)	2(100.0)	1(0.5)	15(34.1)	2(25.0)	4(1.3)	11(2.8)	136(48.7)	231(12.3)
White Sucker	0(0.0)	3(1.1)	2(0.8)	0(0.0)	3(1.6)	1(2.3)	0(0.0)	11(3.6)	141(35.7)	59(21.2)	220(11.8)
Blacknose Shiner	2(1.6)	9(3.2)	19(8.0)	0(0.0)	37(20.0)	15(34.1)	3(37.5)	12(3.9)	0(0.0)	8(2.9)	105(5.6)
Spottail Shiner	1(0.8)	48(17.0)	2(0.8)	0(0.0)	7(3.8)	2(4.5)	0(0.0)	6(1.9)	29(7.3)	3(1.1)	98(5.2)
Logperch	0(0.0)	6(2.1)	0(0.0)	0(0.0)	0(0.0)	3(6.8)	1(12.5)	1(0.3)	53(13.4)	1(0.4)	65(3.5)
Lake Chub	0(0.0)	0(0.0)	6(2.5)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.3)	0(0.0)	7(0.4)
Golden Shiner	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(1.6)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	3(0.2)
Walleye	0(0.0)	0(0.0)	1(0.4)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.1)
Northern Pike	1(0.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.1)
Pumpkinseed	1(0.8)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.1)
Slimy Sculpin	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(2.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.1)
All Species	129	282	238	2	185	44	8	310	395	279	1872
Catch per haul (n)	10.8(12)	31.3(9)	26.4(9)	0.2(9)	20.6(9)	3.7(12)	0.9(9)	34.4(9)	43.9(9)	31.0(9)	19.5(96)

The most common species in each basin, however, was shared by 5 species; yellow perch (Snow and Icy Lakes and Marmion North), mimic shiner (Abie and Moose Lakes), Iowa darter (Slush Lake, Marmion South and Lower Seine Bay), white sucker (Anderson Dam) and blacknose shiner (Marmion South and Central).

The catch per beach seine haul (Table 6) was highest at Anderson Dam (43.9) and lowest at Slush Lake (0.2) and Marmion Central (0.9). During preoperational studies catches tended to be lowest at Slush Lake and were relatively high at Anderson Dam (Ontario Hydro Research Division Report No. 86-38-K). This trend for lower beach seine catches in Slush Lake reflects, at least in part, the poor suitability of the steep sloping shoreline of Slush Lake.

The composition of the catch in beach seines during 1985 was reasonably consistent with earlier years of the Atikokan studies (Table 8). Blacknose shiner, however, which was relatively common in catches 1981-1983 (30-31%) continued its decline in relative importance in 1985 (6%) initiated in 1984 (18%). The catch of all species per haul in 1985 (20) was similar to those of 1982 (24) and 1984 (14) but substantially below those of 1981 (137) and 1983 (68). The latter two years were sampled monthly from May, through October. This trend continues, however, when only May, August and October catches are compared in 1981 and 1983 suggesting that the observed trend is not exclusively related to sampling frequency. The major portion of this observed trend can be attributed to the three most abundant species, blacknose shiner, mimic shiner and yellow perch.

Gill Nets

A total of 184 fish were collected in gill nets set for approximately 2 hours during the evening in May, August and October (Appendix 6). Cisco was the most common species collected overall and was the most common species collected in Snow and Slush Lakes and at Marmion Central and Anderson Dam (Table 9). White sucker, northern pike, or lake whitefish was the most common species collected in at least one of the other basins.

The catch of all species per 2-hr set was highest at Anderson Dam (12.6) and was lowest at Moose Lake (2.1) and Marmion Central (2.4). Catches in Moose Lake continue to be low relative to the other basins since dewatering and refilling.

The relative composition of the gill net catch in 1985 was not substantially different from previous study years (Table 10).

Table 8

COMPARISON OF BEACH SEINE CATCHES 1981-1985

Species	1981	1982	1983	1984	1985
Blacknose Shiner	30 (41)[1]	30 (7)	31 (21)	18 (3)	6 (1)
Mimic Shiner	21 (29)	20 (5)	37 (25)	7 (1)	24 (5)
Yellow Perch	28 (38)	13 (3)	15 (10)	8 (1)	37 (7)
Iowa Darter	2 (3)	9 (2)	4 (3)	38 (5)	23 (5)
White Sucker	10 (14)	3 (<1)	2 (1)	7 (1)	12 (2)
Pumpkinseed	1 (1)	19 (5)	2 (1)	2 (<1)	0 (<1)
Spottail Shiner	1 (1)	2 (<1)	2 (1)	15 (2)	5 (1)
Log Perch	1 (1)	2 (<1)	2 (1)	3 (<1)	4 (<1)
Golden Shiner	4 (5)	2 (<1)	1 (<1)	1 (<1)	0 (<1)
Cyprinidae	0 (<1)	-	2 (1)	-	-
Fathead Minnow	0 (<1)	-	0 (<1)	1 (<1)	-
Ninespine Stickleback	0 (<1)	-	0 (<1)	0 (<1)	-
Slimy Sculpin	1 (1)	1 (<1)	0 (<1)	0 (<1)	0 (<1)
Lake Chub	1 (1)	-	0 (<1)	0 (<1)	0 (<1)
Lake Whitefish	0 (<1)	-	-	-	-
Burbot	0 (<1)	-	0 (<1)	-	-
Walleye	0 (<1)	-	0 (<1)	-	0 (<1)
Bluntnose Minnow	0 (<1)	-	-	-	-
Finescale Dace	0 (<1)	-	-	-	-
Emerald Shiner	0 (<1)	-	-	-	-
Trout-Perch	0 (<1)	-	-	-	-
Redbelly Dace	0 (<1)	-	0 (<1)	-	-
Cisco	0 (<1)	-	-	-	-
Northern Pike	0 (<1)	0 (<1)	0 (<1)	-	0 (<1)
Longnose Dace	-	-	0 (<1)	-	-
Central Mudminnow	-	-	0 (<1)	-	-
Notropis sp	-	-	0 (<1)	-	-
Total Catch	31,131	1,902	14,342	1,285	1,872
Catch Per Haul	137 (87)[2]	24 (24)	68 (54)	14 (14)	20 (20)

[1] Percent composition, and catch per haul,
[2] May, August and October only,
0 = present <0.5% contribution,
- = absent.

Table 9

Catch and Percent Composition of Fish in Gill Nets, Atikokan 1985

Species	Snow Lake	Icy Lake	Abie Lake	Slush Lake	Moose Lake	Marmion Lake					Total
						South	Central	North	Anderson Dam	Lower Seine	
Cisco	10(37.1)	3(18.8)	0(0.0)	10(100.0)	0(0.0)	1(6.7)	5(55.6)	2(18.2)	28(44.4)	1(10.0)	60(32.6)
White Sucker	7(25.9)	6(37.5)	2(13.3)	0(0.0)	4(50.0)	3(20.0)	2(22.2)	7(63.6)	4(6.3)	1(10.0)	36(19.6)
Northern Pike	1(3.7)	0(0.0)	13(86.7)	0(0.0)	3(37.5)	2(13.3)	2(22.2)	0(0.0)	8(12.7)	1(10.0)	30(16.3)
Lake Whitefish	0(0.0)	1(6.3)	0(0.0)	0(0.0)	1(12.5)	8(53.3)	0(0.0)	0(0.0)	11(17.5)	5(50.0)	26(14.1)
Yellow Perch	9(33.3)	4(25.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	13(7.1)
Walleye	0(0.0)	1(6.3)	0(0.0)	0(0.0)	0(0.0)	1(6.7)	0(0.0)	2(18.2)	12(19.1)	2(20.0)	18(9.8)
Pumpkinseed	0(0.0)	1(6.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.5)
All Species	27	16	15	10	8	15	9	11	63	10	184
Catch per 2hr Set	5.4	3.2	3.0	2.7	2.1	3.0	2.4	2.9	12.6	2.7	4.0
Number of Sets	4	4	4	3	3	4	3	3	3	3	

Table 10

Comparison of Gill Net Catches 1982-1985

Species	1982	1983	1984	1985
Cisco	20(1.2)[1]	31(1.6)	19(0.6)	33(1.3)
White Sucker	26(1.6)	23(1.2)	21(0.7)	20(0.8)
Northern Pike	18(1.1)	12(0.6)	19(0.6)	16(0.6)
Lake Whitefish	17(1.1)	16(0.8)	13(0.4)	14(0.5)
Walleye	12(0.7)	15(0.8)	23(0.8)	10(0.4)
Yellow Perch	6(0.4)	2(0.1)	4(0.1)	7(0.3)
Burbot	<1(0.1)	<1(0.1)	0(0.0)	0(0.0)
Pumpkinseed	0(0.0)	0(0.0)	0(0.0)	<1(0.1)
Total Catch	344	644	98	184
Catch per 2 hr Set (May, Aug and Oct)	6.2 (6.2)	5.2 (4.6)	3.2 (3.2)	4.0 (4.0)

[1] Percent Composition and catch per 2-hour set.

With the exception of walleye, the total catch per unit effort and that of individual species observed during 1985 fell within the range of values reported during 1982 through 1984. The catch per unit effort of walleye (0.4), however, was approximately 50% below that reported 1982 through 1984 (0.7-0.8). Analysis of variance, however, indicated that the reduction in the catch of walleye was not statistically significant.

Age and Year Class Distribution

The age and year-class distribution of fish collected during the commissioning phase are presented in Table 11. Walleye collected during the commissioning period (1984-85) ranged in age from 2 to 13 years with the majority 3 to 7 years old. This range of ages compares well with that observed during the preoperational period (1981-1983). With the exception of 1968 all year classes were represented in the catches of 1981 through 1985. The 1978 year-class appeared to be particularly strong while no weak year classes were apparent.

The range of ages of northern pike during 1984-1985 was similar to that of the preoperational phase. All ages-classes from 1968 to 1982 were collected during the Atikokan studies. Exceptionally strong or weak cohorts were not apparent.

The age distributions of cisco and lake whitefish also did not vary substantially from their distributions in the preoperational phase. All age classes of cisco and lake whitefish from 1970 to 1983 and 1968 to 1981, respectively, were represented. The 1972 and 1973 lake whitefish cohorts appeared to be relatively strong while the 1974 whitefish year-class was not well represented.

Growth

In Table 12, mean fork-length and weight of fish caught during the commissioning phase are compared to those from the preoperational phase. In several instances the fork-length and weight of fish in the commissioning phase varied substantially from those of similarly aged fish during the preoperational studies. For the most part, these differences are attributable to the small sample sizes in most age-classes during the commissioning phase.

With the exception of walleye, no trend in the size of fish at age during the commissioning studies, relative to preoperational studies, was apparent. Walleye, however, tended to be smaller during the commissioning period. This trend is attributed to the less intensive sampling program during commissioning and an

Table 11

Comparison of Age and Year Class Distribution (%)
of Fish Caught During Preoperational (1981-83) and Commissioning (1984-1985) Studies

	Northern Pike		Cisco		Walleye		Lake Whitefish	
Age	Pre-op	Comm	Pre-op	Comm	Pre-op	Comm	Pre-op	Comm
1	0	0	0	4.2	1.2	0	0	0
2	1.1	0	1.4	8.3	5.8	3.7	1.1	0
3	13.6	5.7	16.2	8.3	13.6	13.0	5.6	4.3
4	24.3	11.4	14.9	20.8	11.5	3.7	4.5	4.3
5	23.6	31.4	17.6	20.8	14.8	18.5	13.5	4.3
6	15.7	20.0	5.4	8.3	14.0	14.8	6.7	13.0
7	10.7	8.6	2.7	8.3	7.0	18.5	6.7	17.4
8	5.7	11.4	9.5	12.5	9.5	3.7	7.9	13.0
9	3.2	8.6	13.5	0	10.3	7.4	21.3	8.7
10	1.1	2.9	6.8	4.2	3.7	3.7	15.7	4.3
11	0.4	0	9.5	4.2	3.7	9.3	12.4	17.4
12	0.4	0	2.7	0	2.9	1.9	3.4	13.0
13	0.4	0	0	0	0.8	1.9	1.1	0
14					0.8	0	0	0
15					0	0	0	0
16					0.4	0	0	
Year Class								
83	0	0	0	4.2	0	1.9	0	0
82	0	5.7	0	8.3	0	9.3	0	0
81	0	8.6	1.4	16.7	0.4	7.4	0	8.7
80	3.6	11.4	12.2	12.5	2.5	14.8	1.1	4.3
79	10.4	28.6	14.9	20.8	9.9	14.8	5.6	8.7
78	15.7	17.1	12.2	12.5	20.6	20.4	6.7	17.4
77	22.5	5.7	10.8	8.3	15.2	5.6	5.6	13.0
76	16.8	11.4	5.4	8.3	10.7	7.4	9.0	8.7
75	11.1	11.4	6.8	4.2	9.5	5.6	4.5	4.3
74	8.2	0	13.5	0	9.5	7.4	7.9	4.3
73	4.6	0	9.5	4.2	6.2	1.9	14.6	17.4
72	2.1	0	10.8	0	6.6	3.7	22.5	13.0
71	0.4	0	1.4	0	2.5	0	10.1	0
70	0.4	0	1.4	0	4.1	0	10.1	0
69	0.4	0	0	0	1.2	0	1.1	0
68	0.4	0	0	0	0	0	1.1	0
67	0	0	0	0	0.8	0	0	0
66	0	0	0	0	0.4	0	0	0
n	280	35	74	24	243	54	89	23

Table 12

Mean Fork-Length (mm) and Weight (g) of Fish Collected During Preoperational (1981-1983) and Commissioning (1984-1985) Studies

			Age														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Walleye	FL	Comm	-	242	279	375	365	384	408	479	442	472	519	680	543	-	-	-
		Preop	188	258	300	352	389	419	458	489	499	507	603	588	629	655	-	666
	WT	Comm	-	135	301	825	542	759	829	755	1055	1205	1644	4000	1840	-	-	-
		Preop	58	214	289	490	673	881	1083	1355	1413	1731	2483	2603	3050	3050	-	3800
	N	Comm	0	2	7	2	10	8	10	2	4	2	5	1	1	0	0	0
		Preop	3	14	33	28	36	34	17	23	25	9	9	7	2	2	0	1
Northern Pike	FL	Comm	-	-	357	492	498	562	535	715	659	730	-	-	-	-	-	-
		Preop	-	319	421	462	502	592	636	663	714	697	456	892	900	-	-	-
	WT	Comm	-	-	330	863	970	1316	1117	2931	1867	3500	-	-	-	-	-	-
		Preop	-	320	611	755	965	1703	2019	2344	2897	2433	1675	6500	5300	-	-	-
	N	Comm	0	0	2	4	11	7	3	4	3	1	0	0	0	0	0	0
		Preop	0	3	38	68	66	44	30	16	9	3	1	1	1	0	0	0
Cisco	FL	Comm	115	224	223	262	290	302	307	355	-	335	405	-	-	-	-	-
		Preop	-	185	214	214	254	310	352	371	375	376	408	405	-	-	-	-
	WT	Comm	20	125	120	215	275	340	510	653	-	600	890	-	-	-	-	-
		Preop	-	77	158	131	246	525	635	702	852	853	982	900	-	-	-	-
	N	Comm	1	2	2	5	5	2	2	3	0	1	1	0	0	0	0	0
		Preop	0	1	12	11	13	4	2	7	10	5	7	2	0	0	0	0
Lake Whitefish	FL	Comm	-	-	237	301	415	384	422	432	439	388	438	452	-	-	-	-
		Preop	-	245	269	309	324	350	427	407	424	434	457	483	494	-	-	-
	WT	Comm	-	-	150	600	1050	796	1168	1232	1100	880	1331	1327	-	-	-	-
		Preop	-	175	290	423	495	723	1248	881	1157	1259	1512	1700	1530	-	-	-
	N	Comm	0	0	1	1	1	3	4	3	2	1	4	3	0	0	0	0
		Preop	0	1	5	4	12	6	6	7	19	14	11	3	1	0	0	0

(C21)

assumed higher proportion of males in the sample during commissioning. In 1981 and 1983, fish were sampled monthly, May through October, and during the spawning run. In 1984 and 1985, sampling was restricted to May, August and October and the spawning run with the majority of walleye sampled during the spawning run. Consequently, a higher proportion of fish in the preoperational sample were collected after May and further into the growing season. Similarly, a larger proportion of walleye in the commissioning sample were collected during the spawning run and almost all of these were male. Male walleye tend to be smaller than females at the same age (Scott and Crossman, 1973).

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REFERENCES

1. Crow, G.E. and C.B. Hellquist. 1981. Aquatic Vascular Plants of New England: Part 2, Typhaceae and Sparganiaceae. New Hampshire Agriculture Experiment Station Bulletin 517. University of New Hampshire. Durham, New Hampshire. 21 pp.

2. Greig, L.A., Cunningham, G.L., Jones, M.L. and Everitt, R.R., 1984. Report of a workshop to consider the scope and objectives for post-operational environmental monitoring at the Atikokan TGS. ESSA LTd for Ontario Hydro, Toronto, 88 p.

3. Fassett, N.C. 1975. A Manual of Aquatic Plants. The University of Wisconsin Press. Madison, Wisconsin. 405 pp.

4. Gleason, H.A. 1968. The New Britton and Brown Illustrated Flora of the Northeasten United States and Adjacent Canada. Hafner Publishing Co., Inc. New York.

5. Haag, R.W. and P.R. Gorham. 1977. Effects of Thermal Effluent on Standing Crop and Net Production of Elodea canadensis and Other Submerged Macrophytes in Lake Wabamun, Alberta. J. Appl. Ecol. 14: 835-852.

6. Hellquist, C.B. and G.E. Crow. 1980. Aquatic Vascular Plants of New England: Part 1. Zosteraceae, Potamogetonaceae, Zannichelliaceae, Najadaceae, New Hampshire Agriculture Experiment Station Bulletin 515. University of New Hampshire, Durham, New Hampshire. 68 pp.

7. Hutchinson, G.E. 1975. a Treatise on Limnology. Volume III. Limnological Botany. John Wiley & Sons. New York, N.Y. 660 pp.

8. Ontario Hydro Design and Development Division - Generation Report No. 86308. Water Temperatures in the Vicinity of Atikokan TGS during commissioning, June-October, 1985. D.W. Lawler 1986.

9. Ontario Hydro Research Division Report No. 85-81-K. Atikokan GS Preoperational Aquatic Survey Year III, 1983-1984. G.T. Haymes, 1985.

10. Ontario Hydro Research Division Report No. 85-333-K. Atikokan GS Interim Aquatic Survey, January 1984 to June 1985. G.T. Haymes, 1985.

11. Ontario Hydro Research Division Report No. 86-38-K. Atikokan GS Preoperational Aquatic Survey Three-Year Summary, 1981-1983. G.T. Haymes, 1986.

12. Riley, J.L. 1979. Ontario's Pondweeds (genus Potamogeton). Ont. Field Biol. 33: 1-26.

13. St. John, H. 1965. Monograph of the Genus Elodea (Hydrocharitaceae). IV. The Species of Eastern and Central North America. Rhodora, 67: 1-35, 155-180.

14. Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Res. Bd. Can. Bull. 184. 966 pp.

15. Sculthorpe, C.D. 1967. The Biology of Aquatic Vascular Plants. Edward Arnold (Publishers) Ltd. London. 610 pp.

16. Voss, E.G. 1972. Michigan Flora. Part 1. Gymnosperms and Monocots. Bulletin 55. Cranbrook Institute of Science, Bloomfield Hills, Michigan. 488 pp.

Appendix 1

Temperature and Dissolved Oxygen Profiles August and October 1985

Temperature (°C)

	Snow Lake		Icy Lake		Abie Lake		Anderson Dam		Marmion Central	
Depth	8/7	10/24	18/7	10/23	8/7	10/23	8/7	10/22	8/7	10/22
0	20.5	10.5	21.9	9.6	22.7	8.6	21.4	7.0	21.2	7.8
1	20.6	10.4	21.8	9.6	22.3	8.5	21.4	7.0	21.2	7.8
2	20.6	10.4	21.8	9.5	21.9	8.4	21.3	7.0	21.2	7.8
3	20.6	10.4	21.5	9.5	21.3	8.3	20.8	7.0	21.2	7.8
4	19.7	10.4	20.1	9.2	20.5	8.3	20.1	7.0	21.2	7.8
5	17.5	10.4	17.4	9.2	18.5	8.1	18.6	7.0	21.2	7.8
6	15.3	10.4	16.9	8.6	16.2	8.1	17.6	7.0	21.2	7.7
7	13.6	10.3	14.6	8.6	15.0	8.0	15.5	7.0	21.2	7.7
8	12.5	10.3	12.5	8.5	13.2	8.0	14.4	7.0	16.6	7.7
9	12.1	8.7	10.9	8.2		8.0		7.0	15.2	7.7
10		8.3	10.1	8.1		7.8		7.0	14.9	7.7
11				7.9					14.6	7.7
12				7.9					14.2	7.7

Dissolved Oxygen (ppm)

0	9.8	MNF	9.8	12.6	9.6	12.4	10.0	13.2	9.4	13.0
1	9.7		9.7	12.6	9.6	12.5	9.8	13.3	9.5	13.0
2	9.3		9.6	12.6	9.6	12.6	9.2	13.0	9.5	13.0
3	9.2		9.4	12.6	9.5	12.5	8.8	13.0	9.4	13.0
4	7.6		7.8	12.4	9.1	12.3	7.3	12.8	9.4	13.0
5	4.5		2.6	12.4	6.3	12.2	5.5	12.8	9.4	13.0
6	0.3		1.9	12.4	1.8	12.2	4.2	12.9	9.4	13.0
7	0.0		0.0	12.4	0.4	11.9	0.9	12.9	9.6	13.0
8	0.0		0.0	12.4	0.0	11.9	0.0	12.8	5.3	13.0
9	0.0		0.0	12.0		11.6		12.9	4.1	13.0
10			0.0	12.0		11.4		12.9	3.8	13.0
11			0.0	11.8					3.4	13.0
12			0.0	11.8					2.1	13.0

MNF - meter not functioning

Appendix 1 continued

Temperature (°C)

	Slush Lake		Marmion South		Marmion North		Lower Seine		Moose Lake	
Depth	8/9	10/24	8/7	10/23	8/7	10/24	8/8	10/23	8/7	10/22
0	23.3	7.2	21.2	8.1	21.5	8.0	22.6	8.2	21.8	7.3
1	22.2	7.2	21.2	8.0	21.4	8.0	22.6	8.1	21.8	7.3
2	21.8	7.2	21.1	8.0	21.3	8.0	21.9	8.1	21.6	7.3
3	21.8	7.2	20.8	8.0	21.2	8.0	21.8	8.1	21.4	7.3
4	19.6	7.2	20.5	8.0	20.8	8.0	21.5	8.1	21.0	7.3
5	14.6	7.2	20.1	8.0	19.7	8.0	20.6	8.1	20.6	7.3
6	11.5	7.2	19.4	8.0	19.5	8.0	18.7	8.1	20.4	7.3
7	9.5	7.2	18.7	8.0	17.1	8.0	16.5	8.1	20.3	7.3
8	6.4	7.1	17.0	8.0	15.5	8.0	14.8	8.1	20.1	7.2
9	5.8	7.1	14.7	8.0	13.6	8.0	11.5	8.0	19.8	7.2
10	5.3	7.1	12.9	8.0	11.5	8.0	10.2	8.1	19.6	7.2
11	5.0	7.1	10.8	7.9	10.2	8.0	8.1	8.1	19.3	7.2
12	4.6	6.7	8.6	7.9	8.6	8.0	7.4	8.1	19.0	7.2
13	4.5	6.5	7.3	7.9	7.4	8.0	7.0	8.1	17.3	7.2
14	4.5	6.5		7.5	6.8	8.0	6.7	8.1	12.8	7.2
15	4.5	6.2		7.4	6.5	8.0	6.6	8.1	8.5	7.1
16		6.0		7.4		8.0	6.5	8.1	6.8	7.1
17				7.4		8.0	6.4	8.1	6.2	7.1
18				7.4		8.0	6.1	8.1	6.0	7.1
19								8.1	5.3	7.1
20								8.1	4.9	7.0
21								8.0	4.7	
22								8.0	4.5	
23								8.0	4.4	
24									4.3	
25									4.2	
26									4.1	
27									4.1	
28									4.0	
29									4.0	
30									4.0	
31									3.9	
32									3.8	
33									3.8	
34									3.9	
35									3.9	
36									3.9	
37									3.9	

Dissolved Oxygen

0	8.7	MNF	9.8	13.1	9.7	MNF	9.6	12.7	9.6	13.2
1	8.7		9.6	13.2	9.5		9.4	12.5	9.6	13.2
2	8.7		9.6	13.2	9.5		9.3	13.0	9.5	13.2
3	8.6		9.5	13.1	9.3		9.3	13.0	9.5	13.2
4	9.5		9.5	12.5	9.1		8.9	12.8	8.7	13.2
5	9.9		9.1	12.5	8.5		8.6	12.8	8.4	13.1
6	9.9		8.0	12.5	8.4		7.2	12.8	8.0	13.1
7	9.9		7.3	12.5	5.5		4.5	12.4	7.5	13.1
8	6.6		5.6	12.5	5.0		4.6	12.3	7.0	13.0
9	2.3		4.0	12.5	4.7		4.0	12.1	6.7	13.0
10	0.2		3.7	12.5	3.6		3.8	12.6	6.3	13.0
11	0.0		2.9	12.2	3.0		3.6	12.6	5.2	13.0
12	0.0		2.6	11.6	1.6		3.2	12.6	4.7	13.0
13	0.0		1.7	11.8	0.0		2.7	12.6	4.1	13.0
14	0.0			11.8	0.0		2.0	12.5	2.9	12.8
15	0.0			11.8	0.0		0.0	12.5	3.3	12.8
16				11.8			0.0	12.4	4.7	12.6
17				11.1			0.0	12.2	4.8	12.6
18				11.1			0.0	12.2	4.9	12.4
19								12.2	5.8	12.6
20								12.0	5.7	12.6
21								11.9	5.7	
22								11.9	5.3	
23								11.9	5.7	
24									5.4	
25									5.6	
26									5.4	
27									4.9	
28									4.2	
29									3.6	
30									3.1	
31									3.1	
32									2.3	
33									0.0	
34									0.0	
35									0.0	
36									0.0	
37									0.0	

MNF - meter not functioning

APPENDIX 2

Scientific and Common Names of Macrophytes cited in the text
(from Fassett 1975)

Scientific Name	Common Name
Beckmannia syzigachne	Slough Grass
Brasenia schreberi	Water Shield
Calamagrostis canadensis	Bluejoint
Callitriche hermaphroditica	Water Starwort
C. heterophylla	Water Starwort
Ceratophyllum demersum	Coontail
Dulichium arundinaceum	Three-way Sedge
Eleocharis acicularis	Needle Rush
E. paulustric	Creeping Spike Rush
Elodea canadensis	Waterweed
Equisiteum sp	Scouring Rush (Horsetail)
Eriocaulon septangulare	Pipewort
Glyceria borealis	Manna Grass
G. grandis	Reed Meadow Grass
Hippurus vulgaris	Mare's tail
Juncus effusus	Soft Rush
Lemna sp	Duckweed
Lobelia dortmanna	Water Lobelia
Mimmulus ringens	Monkey Flower
Myriophyllum alterniflorum	Water Milfoil
M. exalbescens	Water Milfoil
Najas flexilis	Bushy Pondweed
Nuphar sp.	Yellow Water Lily
Nymphaea odorata	Water Lily
Polygonum natans	Smartweed
Potamogeton alpinus	-
P. amplifolius	Large-leaf Powdweed (Muskie, Bass Weed)
P. epihydrus	Leafy Pondweed
P. foliosus	Leafy Pondweed
P. friesii	-
P. gramineus	Variable Pondweed
P. natans	Floating Brownleaf (Floating-leaf Pondweed)
P. obtusifolius	-
P. pectinatus	Sago Pondweed
P. Praelongus	-
P. richardsonii	Clasping-leaf Pondweed (Bass Weed)
P. robbinsii	Robbins' Pondweed
P. spirillus	-
P. strictifolius	-

P. Vaseyi	-
P. zosteriformis	Flat-stemmed Pondweed
Ranunculus tricophyllus	Buttercup (Crowfoot)
Rorippa islandica	Cress
Sagittaria sp.	Arrowhead (Duck Potato)
Scirpus cyperinus	Bulrush
S. validus	Softstem Bulrush (Great Bulrush)
Sium suave	Water parsnip
Sparganium fluctuans	Floating-leaf Bur Red (Broad Ribbon-leaf)
Typha spp	Cattail
Utricularia vulgaris	Bladderwort
Vallisneria americana	Wild Celery (Tape Grass)

APPENDIX 3

AQUATIC VEGETATION OBSERVED
ALONG TRANSECTS - ATIKOKAN, 1985

APPENDIX
MACROPHYTE SPECIES PRESENT ALONG TRANSECTS IN SNOW LAKE IN 1985

TRANSECT	1	2	3	4
Chara spp	X	X		X
Elodea canadensis	X	X	X	X
Myriophyllum exalbescens	X	X	X	
Najas flexilis			X	X
Potamogeton amplifolius	X	X	X	
Potamogeton epihydrus	X	X	X	X
Potamogeton foliosus		X		
Potamogeton obtusifolius	X	X	X	X
Potamogeton pusillus	X	X		X
Potamogeton richardsonii	X	X	X	X
Potamogeton robinsii	X	X	X	X
Ranunculus tricophyllus		X	X	
Scirpus spp		X		
Typha spp		X		

APPENDIX
MACROPHYTE SPECIES PRESENT ALONG TRANSECTS IN ICY LAKE - WEST BAY IN 1985

TRANSECT	1	2	3	4	5	6	7	16	17
Callitriche hermaphroditica		X	X		X	X		X	
Elodea canadensis					X	X			
Glyceria canadensis									
Megalodonta beckii	X	X	X	X	X	X		X	
Myriophyllum exalbescens					X	X	X		X
Najas flexilis		X	X		X	X		X	
Nymphaea odorata				X				X	
Potamogeton epihydrus									
Potamogeton obtusifolius				X	X				
Potamogeton praelongus									
Potamogeton pusillus									
Potamogeton richardsonii					X	X	X	X	X
Potamogeton robbinsii		X	X	X	X	X	X	X	X
Potamogeton zosteriformis				X	X				
Ranunculus tricophyllus		X	X		X			X	
Scirpus spp									
Sparganium fluctuans									
Typha spp									
Utricularia vulgaris					X				

APPENDIX
MACROPHYTE SPECIES PRESENT ON TRANSECTS IN ICY LAKE EAST BAY IN 1985

TRANSECT	8	9	10	11	12	13	14	15
Elodea canadensis						X	X	X
Megalodonta beckii							X	X
Myriophyllum exalbescens	X	X	X				X	X
Najas flexilis					X		X	X
Nymphaea odorata	X	X	X	X	X		X	
Potamogeton amplifolius								X
Potamogeton epihydrus							X	X
Potamogeton praelongus								X
Potamogeton pusillus								X
Potamogeton richardsoni							X	X
Potamogeton robbinsii	X	X	X	X			X	X
Potamogeton strictifolius							X	X
Potamogeton zosteriformis							X	X
Scirpus sp							X	
Sparganium sp							X	
Typha sp							X	
Vallisneria americana								X

APPENDIX
MACROPHYTE SPECIES PRESENT ON TRANSECTS IN ABIE LAKE IN 1985

TRANSECT	1	2	3	4
Brasenia schreberi	X	X		
Chara sp	X	X	X	
Elodea canadensis	X		X	
Glyceria canadensis	X			
Isoetes sp	X			
Megalodonta beckii	X	X	X	X
Myriophyllum alterniflorum	X			X
Myriophyllum exalbescens	X	X	X	X
Najas flexilis	X	X	X	X
Nuphar sp	X			
Nymphaea odorata	X	X	X	X
Nymphaea tetragona		X		
Polygonium natans	X			
Potamogeton epihydrus				X
Potamogeton gramineus	X	X		
Potamogeton natans			X	
Potamogeton richardsoni	X		X	
Potamogeton robbinsii	X	X	X	
Potamogeton strictifolius	X	X		X
Sagittaria spp	X			X
Sium suave	X			
Sparganium fluctuans	X			
Utricularia vulgaris		X	X	
Typha spp	X	X	X	X

APPENDIX
MACROPHYTE SPECIES PRESENT ALONG TRANSECTS IN MARMION LAKE NEAR ABIE IN 1985

TRANSECT	1	2	3
Callitriche hermaphroditica		X	
Chara sp	X		
Eloda canadensis	X	X	X
Juncus effusus		X	
Myriophyllum alterniflorum	X	X	X
Myriophyllum exalbescens	X	X	X
Najas flexilis	X	X	X
Nymphaea odorata			
Potamogeton amplifolius	X	X	
Potamogeton epihydrus	X	X	
Potamogeton gramineus		X	
Potamogeton richardsoni	X		X
Potamogeton robbinsii	X	X	X
Potamogeton spirillus		X	
Potamogeton zosteriformis	X	X	X
Sagittaria sp		X	
Sparganium fluctuans		X	X

APPENDIX
MACROPHYTE SPECIES PRESENT ALONG TRANSECTS IN MARMION LAKE AT ANDERSON DAM IN 1985

TRANSECT	1	2	3	4
Callitriche hermaphroditica	X	X	X	X
Ceratophyllum demersum	X	X	X	X
Chara sp	X			
Eleocharis sp				X
Elodea canadensis	X	X	X	X
Glyceria sp	X	X	X	X
Myriophyllum alterniflorum				X
Myriophyllum exalbescens	X	X	X	X
Najas flexilis	X	X		
Potamogeton epihydrus				
Potamogeton gramineus				X
Potamogeton natans				
Potamogeton praelongus		X	X	
Potamogeton pusillus		X	X	
Potamogeton richardsoni	X	X	X	X
Potamogeton zosterifonis	X	X	X	X
Ranunculus tricophyllus	X	X	X	X
Sagittaria sp				X
Scirpus sp				X
Sium suave				X
Typha sop				X

Appendix 4

Larval Fish Catch in Duplicate 5-Minute Tows
Atikokan, May 1985

Location	Date	White Sucker	Lake Whitefish	Yellow Perch	Cisco	Gasterosteidae	Unidentified
Snow Lake							
Inlet	05/02				3		
	05/30			9			1
Outlet	05/02						
	05/30		2	5			
Icy Lake							
Inlet	05/01						
	05/30			4			
Outlet	05/01						
	05/30		2	3			
Abie Lake							
Inlet	05/01		4				
	05/29		2	3	1		
Outlet	05/01						
	05/29	3	1	4	4		
Marmion South							
Inlet	05/01				3		
Open Water	05/01				1		
	05/30		7				
Marmion Central	05/28		13	6			
Marmion North	05/22		2	1			
Lower Seine	05/28		5	4			
Anderson Dam	05/22		1	5		1	
Moose Lake	05/22		3	8			
Slush Lake	05/31			142			

Appendix 5

Fish Catch in Triplicate Beach Seine Hauls
Atikokan 1985

Species	Snow Lake		Icy Lake	Abie Lake	Slush Lake	Marmion Lake					Moose Lake
						South		Central	North	Lower Seine	Anderson Dam	
	E	L				E	L					
May												
Blacknose Shiner			4			15	6	3		6		37
Mimic Shiner		16	19	14				1		3	6	14
Iowa Darter	3	35	2	2	1	9	1	1	2	87	5	
White Sucker			3			1						1
Yellow Perch		50	169						265			19
Spottail Shiner			32								2	6
Logperch			2				3				7	
Cyprinidae											1	
Slimy Sculpin							1					
Pumpkinseed		1										
Northern Pike		1										
Golden Shiner												3
August												
Blacknose Shiner			5	17					9	2		
Mimic Shiner	9		1	164					1	13	76	100
Iowa Darter	11		1	3	1	4		1	2	44	3	1
White Sucker			17	2					11	59	141	2
Yellow Perch			23	23		1		1	10	44	68	1
Spottail Shiner	1		16	2		2			6	3	24	1
Logperch			5					1	1	1	46	
Walleye				1								
Lake Chub				6							1	
October												
Blacknose Shiner	2			2								
Iowa Darter			1	2		2				5	3	
Yellow Perch										12	10	
Spottail Shiner											3	

E - Early May, L - Late May (all others Late May)

Appendix 6

Gill Net Catch - Atikokan 1985

Species	Snow Lake		Icy Lake		Abie Lake		Slush Lake	Moose Lake	Marmion Lake						Total
									South		Central	North	Anderson Dam	Lower Seine	
May 1985 Dates	E	L	E	L	E	L	L	L	E	L	L	L	L	L	
Lake Whitefish										3				3	6
Cisco				2							2		4	1	9
Northern Pike					2			1	2				2	1	8
White Sucker		6		3		2		4			2	4			21
Yellow Perch		9	4												13
Walleye													5		5
August 1985							Ø				Ø				
Lake Whitefish										5				2	7
Cisco										1		2			3
Northern Pike					4			1					2		7
White Sucker		1		2						1		1	4		9
Yellow Perch															0
Walleye													3		3
October 1985															
Lake Whitefish			1					1					11		13
Cisco		10	1				10				3		24		48
Northern Pike		1			7			1			2		4		15
White Sucker			1							2		2		1	6
Yellow Perch															0
Walleye			1							1		2	4	2	10
Pumpkinseed			1												1
Total		27		16		15	10	8	15		9	11	63	10	184

E - Early May

L - Late May

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